THE

ELECTRICAL REVIEW.

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GERMAN FUEL PROBLEMS.

IN many respects the fuel problem has been much more serious to the enemy than to us for, although we have been amiable enough to tolerate German influence and ownership in time of peace, and a state of affairs in the colliery world in time of war, which has, in both instances, been a great source of moral and material benefit to the enemy, still we have at least had the seas open to our shipping, whereas Germany has had to depend almost entirely on her own fuel resources. These are, of course, very great, but the interruption of imports and exports has caused notable changes or rather developments in the utilisation of German fuel.

To a far greater extent than in this country, the value of by-products from coal was appreciated in Germany before the outbreak of war, and the technology of separating and utilising these by-products had been carried to a very high level. In the aggregate, German coal production exceeds the needs of the country, and the imports, though considerable, were only of special coals (such as our anthracite, the full national value of which will apparently be realised only when the beds are exhausted). On the other hand, German fuel exports were very largely coal briquettes and coke, *i.e.*, coal from which the valuable by-products had been extracted.

Since the outbreak of war the value of those by-products has much increased, for they include toluene (the basis of the high explosive "T.N.T."), coal tar oil (a good substitute for petroleum), and benzol (which is equal, or superior, to petrol). The importance of the liquid fuels derived from coal is particularly great since the enemy relied for petroleum and petrol on imports from America and Russia, excepting those from the oil-fields of Galicia.

The increased military demands for coal by-products, the practically vanished outlet for coke by export, and the intensified industrial and military demands for coal for those purposes to which coke is not applicable, have all combined to increase the importance of using coke wherever possible, as, for example, in admixture with coal for boiler-firing. The "influence" of the State has been brought to bear on this matter.

Just what the practice of efficient fuel technology is worth to Germany at the present moment it is difficult to estimate. Its methods and its practice have been considerably improved and extended since the outbreak of war, and, when peace is declared, the ways of economy and efficiency will undoubtedly remain in use. They will constitute an important asset in the industrial war that is to come, by making for cheapened power production and for conservation and cheapening of materials. The fundamental practice on which this asset is based is that of burning as little "raw" coal as possible. A large percentage of coal as mined is worth far more as a material for manufacture or as a secondary fuel than as fuel in the state in which it first exists. The erection of by-product plant is not the work of a moment, and we are probably denied the full benefit of its use during the period of the war; but it is a matter of the very highest importance that from now onwards we should utilise coal very much more efficiently than in the past—use it, in fact, as Germany was doing to a great extent as a matter of economic policy before the war, and as she has since been compelled to do to a very much greater extent.

"Be Prepared."

During the period of the war we have published a number of articles on the trade position in other countries, so that those interested in the electrical industry might learn from thoroughly qualified experts just what are the outstanding features of the situation and make preparations accordingly. For years before the war we made it our business to place such matters periodically before our readers, many of whom made profitable use of the information that we were able to lay before them. Even then the urgent advice was continually coming to us from all parts of the world, and we were passing it on, that British traders must prepare more energetically for meeting the serious industrial position that had arisen consequent upon Teutonic competition, in which our rivals did not disguise their desire to throttle our industries. We were always being told to make plans, to develop schemes, to adopt this, that, and the other move to counteract German influence. To-day, when, roughly speaking, we have the world largely to ourselves, because of the removal of German influence for the time being, the same kind of counsel is being received—Be prepared for what is coming!—though unfortunately our pre-occupation with the manufacture of war munitions and the general financial situation prevent our following this injunction as we might have done in days of peace. But as we have said before, not all the departments of our manufacturing businesses are engaged on war munitions, and in addition to our needing to make special efforts to maintain our exports, the advice, "Be Prepared!" should be very seriously considered in its relation to after-war business. Stocks abroad are depleted, there will be big demands for all classes of electrical manufactures, and those who are able to offer them will find a ready sale.

The article by "Anglo-Egyptian," on "British Electrical Trade with Egypt," which appears elsewhere in this issue, is by no means the least interesting of our series of articles on the foreign markets; indeed, we believe it to be one of the most practical and suggestive. It is certainly timely, and the views are those of one most highly qualified to report upon the Egyptian electrical trade position. On this point the reader need have no misgivings—he would certainly have none were we at liberty to disclose the writer's identity.

Rubber.

Signs of returning vitality in the rubber market are still lacking, and market conditions, taken as a whole, remain disappointing, prices showing a drooping tendency, with only fitful gleams of recovery, although very fair quantities of material are supposed to have been disposed of out of the liberal arrivals coming to hand. While there is very little indeed to induce much hopefulness concerning the market in its present mood, it is regarded as somewhat surprising that prices should have displayed so much resistance, though the opinion that the underlying conditions are stronger than generally supposed finds fewer advocates than it did a month ago. The lingering hopes that a reawakening of interest on a large scale on the part of United States consumers would develop have not yet matured, though there are still chances in this respect. Generally, the statistical position remains fair, and this rather tends to restrain offers by importers in the hope that the approach of the new season may bring about some further developments.

The July statistics here showed a reduction in the warehouse stocks of plantation rubber, the quantities actually delivered having exceeded the arrivals by about 1,000 tons. Larger supplies, however, are expected during the autumn, and the information coming to hand as to the progress of operations in the Eastern plantations is entirely satisfactory. There has lately been a reduction in the premium of Highland smoked sheets over other descriptions of fine material, the change in the position being attributed to the fact that there has been considerable improvement effected in the curing process recently, owing to the adoption of more scientific methods. The following details show the exports of plantation rubber from the Federated Malay States during the past three years:—

	1913. Tons.	1914. Tons.	1915. Tons.
January ...	2,131	2,542	3,473
February ...	1,757	2,364	3,411
March ...	1,737	2,418	2,418
April... ...	1,626	2,151	2,777
May	1,225	2,069	2,708
June... ...	2,005	2,306	3,403
July	1,781	2,971	3,687
Total ...	12,262	16,821	22,877

Official figures recently issued by the Dutch authorities reveal a marked growth in the rubber exports from Java, the 1914 figures just available showing an increase of 50 per cent. compared with 1913. It is pointed out that in the latter year the Netherlands and the United Kingdom were almost equal participants in Java rubber, but during 1914 the latter country increased its purchases by more than a million lbs.

German Espionage.

A "Neutral," writing in the *Times* of August 21st, drew attention once more to the German system of espionage. He pointed out that when our Government made the statement that the German spy system in this country had been broken up, the announcement was received by the enemy with shouts of derision. He went on to say that spying in the Fatherland had been reduced to a fine art, and that, wholly apart from military matters, it was practised by peaceful citizens. Your German firm even had spies amongst those who were employed by a rival in trade!

Those who are concerned with electrical matters in this country could say something of the manner in which our whilom German rivals have endeavoured to filch orders which ought to have come to English firms.

One can recall an instance of "the German method" which occurred in relation to a power station not 100 miles from the offices of the Electrical Review. New dynamos were required. Invitations to tender were sent to certain English firms, the directors being determined to support home industry. The lowest tender received was about £20,000—the exact figure is of no consequence. Before the order was placed, a polite German was shown into the office of the managing director. After a little general talk about the weather, he offered, on behalf of his German principals, to supply the goods for £18,000. In this instance he received but short shrift. The managing director told him that his company declined "To provide any funds for the building of German Dreadnoughts." Subsequent inquiry showed that the German spy had been "nosing around" among, and possibly bribing, the clerks, in order to acquire sufficient information to enable him to advance his tempting offer.

These Teutonic methods are not the mere growth of yesterday. They are apparently characteristic of the race When reading (for the *n*th time) Smiles's "Life of James Watt," we recently discovered an example which dates back well into the Eighteenth Century. Having drawn attention to the fact that after the efficiency of Watt's engine had been proved in the Cornish mines, orders for the engines came in from France and Holland, the biographer proceeds:—

> Watt was more alarmed than gratified by the foreign orders, fearing that the engine would be copied and extensively manufactured abroad, where patents had not yet been secured. He did not see that the best protection of all was in the superiority of his mechanics and tools, enabling first-class work to be turned out—advantages in which the Soho firm had the start of the world. It is true his mechanics were liable to be bribed, and foreigners were constantly haunting Soho for the purpose of worming out the secrets of the manufacture, and decoying away the best men. Against this every precaution was taken, though sometimes in vain. Two Prussian engineers came over from Berlin in 1779, to whom Watt showed every attention; after which, in his absence, they got into the engine room and carefully examined all the details of "Old Bess," making notes. When Watt returned he was in high dudgeon, and wrote to his partner (Boulton) that he "could not help it, unless by discountenancing every foreigner who does not come avowedly to have an engine."

We may be pretty sure that henceforth manufacturing firms in this country will be strictly on their guard against German methods of peaceful penetration

SOME MOTORS I HAVE MET.

By E. F. BUTLER.

In an experience which covers some thousands of machines, although the majority call for no comment, yet some are remembered, either for something out of the ordinary in their construction or operation, or else for some fault unusual or hard to locate. An instance of the former class was a 20-H.P. motor in the Midlands, driving a foundry blower. The remarkable thing about it was that it appeared to have only one terminal. Curiosity prompted the writer to investigate, and as the owner had no objection he did so. The terminal in question was a huge brass affair, almost big enough to lift the motor by, and fitted into an insulating bush screwed into the place where the eye-bolt usually is. It turned out that the motor was a two-pole series machine, the two armature leads being connected between the two field coils, in place of the usual connector, one end of the field coils being taken to the only terminal, while the other end was connected to one of the holding-down bolts. The starter was connected up as usual, being in series with the terminal. The other main was connected to an iron gaspipe. The return from the motor was *via* the holding-down bolts, which went through a girder, thence to the corrugated iron motor-shed, and on to an iron standard supporting a crane track to which the gaspipe was also connected.

Although not a motor, another machine, located about half a mile from the Bank, may be noticed. This is an old Gramme dynamo, of about 6 volts, used for plating, which has been running for over 40 years, and is still in daily use. The remarkable part about it is the brushgear.

The brushes, copper, of course, are fixed in a clamp which is free to swing round the spindle. Clamped in with the brush is a brass plate, nearly the same size as the brush, with a hole in the end. Hooks are fixed in the wooden beams above the machine, and a cord is tied through the hole in the brass plate and passed over the hook. Pressure on the brushes is obtained by hanging weights on the free end of the cord. When trade is slack a few large iron nuts are sufficient, but in busy times anything up to about 14 lb. of metal are attached, the quantity in use serving as a crude ammeter. It is interesting to note that during the whole time this machine has been running, the only renewals, apart from brushes, have been two new commutators and one new set of bearings.

The electrical end often receives the blame for troubles which are purely mechanical. Probably the most common complaint in this connection, more particularly with belt drives, is that the motor goes too slow, or will not take the load. The writer has come across several instances of this, and in most cases the trouble can be traced to excessive slipping of the belt. It may be pointed out that when there is more than one belt between the motor and the driven machine, it is not necessarily the motor belt that is slipping.

A metal pulley, however long it may run, does not get polished if the belt does not slip unduly, but has a leaden appearance. When slipping takes place, the pulley will be bright and shine like polished silver. An examination of the belt will usually show it to be smooth and glazed on the inner side, and in bad cases the smell of burnt leather will be noticed. A speed counter will easily confirm whether the motor is running at its proper speed or not.

On one occasion the driving end bearing of a large motor in a saw mills seized badly. It had practically welded on, and as much of the shaft as was visible between the end plate and pulley was blue from heat. The oil well was nearly full of good clean oil, and, on first thoughts, it almost seemed as if the law of cause and effect had ceased to work. The common-sense view, however, was that the colour of the shaft showed that it must have reached a temperature of somewhere in the neighbourhood of 500° F., and long before that time the oil would have been volatilised or burnt up. The obvious conclusion arrived at was that the oil had been added after the shaft had seized. The attendant was asked point blank if this was the case, and eventually he admitted that it was so.

The truth of the matter probably was that the motor had been out of use for some time, was in an exposed position by the river side, and, being cold weather, the oil had thickened sufficiently to prevent the ring revolving.

About the same time the writer came across another bearing trouble, this time in a wood-working shop, the owner doing jobbing work for the furniture trade. He had prospered in a small way, and installed a larger motor. After it had been running for a few weeks complaint was made that the commutator end bearing was running hot at intervals.

The first time it did so the owner washed it out with paraffin, and, after refilling with fresh oil, it ran all right. A few days afterwards it again ran hot, and the owner asked to have the trouble investigated. It turned out that the motor was fixed close to a moulding machine, a tool which runs at a very high speed and throws off a lot of chips. The cause of the trouble was soon apparent. The end of the oil well was open, and occasionally a chip of wood flew in and dropped in the oil well, got picked up by the ring, and lodged between the ring and the bush; in fact the ring was actually seen resting on a chip. A cover was fitted over the end of the oil well and the trouble did not recur.

An unusual case of bearing trouble was met with a few years ago on a motor in a steel works. Again, the complaint was a heated bearing, this time on the driving end. The motor was an old two-pole over-type machine, having split bearings, with caps held down by set screws.

On removing the bearing cap it was found that the oil ring had cut a groove all round the shaft as neatly as if it had been turned to a depth of about a quarter of an inch. The shaft was so weakened that it had to be renewed. The explanation of the trouble seems to be that the ring was very heavy, being about a quarter of an inch wide by three-eighths of an inch deep. On that account it travelled much slower than the motor shaft, picked up particles of slag and grit, acting practically as a saw.

Let me give a final instance of bearing trouble. The hoist of an overhead travelling bearing crane was driven by gearing from a 20-H.P. motor. After it had been in use a short time one of the armature bands came off, and it was found that the lift in the bearings was excessive, the armature being practically on the pole pieces. The motor was taken apart, and the bearings tried on the shaft. It was somewhat surprising to find that they were a very good fit and showed no signs of wear. The bearings were next tried in the end-plate, and the cause of the trouble was apparent. The wear was on the outside.

The bearing was 6 in. long, and the outside was left rough, excepting for about 1 in. at the centre, which was turned to a radius. The seating in the end-plate was bored out parallel, consequently the weight of the armature and the load and the pull of the brake blocks was only taken on a line of contact.

Men who do nothing else but power work often get into the habit of locating faults almost automatically by symptoms, without the aid of a testing set or test lamp, and can usually make a very good guess at the trouble. On the other hand, they sometimes guess wrong. Such a case occurred on a metal-cutting saw, in which both the motor and gearing were enclosed. The only indication of the running of the motor was the movement of the saw. When starting up one day the operator was unable to get the saw to move. The electrician, who had examined the motor earlier in the day, came to the conclusion that the starter had burnt out. Borrowing one from a standing machine near by, he connected up and tried again, still without result. Noticing that the no-volt release was energised and holding up the starter arm, he left it so, removed one of the motor covers, and found the motor running merrily. The key had come out of the pinion and the shaft was revolving in the bore of the wheel.

The writer has come across several instances of mice and rats getting into electrical machinery. They usually get in when the machine is warm after a day's run. Generally speaking, no harm is done, excepting to the animals themselves, although in one instance a large rat got into a fan-ventilated motor and wedged up the fan. In another case a rat found its way into a lift controller on 530 volts, and caused a short-circuit.

An unusual fault took place on a motor in a leather works some time ago. The motor was hard to start up, would sometimes race, and at other times run at normal speed, and would flash over frequently.

It was not overloaded, and all connections were apparently in order. It took some time before the trouble was located, but the fault was very simple, after all.

The no-volt coil was in series with the shunt field winding, and the overload release operated in the usual way by short-circuiting the no-volt coil.

An intermittent break was found in the no-volt coil, and what happened was this: The contact on the starter arm was burnt and roughened, so that it did not fly back when the current was shut off. When the shunt field was opened by the break in the no-volt coil, the armature took an excessive current, which pulled in the overload coil and re-established the field. Sometimes the overload stuck in and kept the field, and sometimes it dropped, and the motor either flashed over or pulled it in again.

Another case had somewhat similar features. A new motor and starter, which had previously been tested and run satisfactorily on load, were packed and sent off to a customer about a 100 miles away.

A short time after, an angry purchaser telegraphed up to say that the motor was no good, and the starter got red-hot every time an attempt was made to start the motor.

A man was dispatched to the scene, and found the motor already packed up for returning. It was hastily connected up without removing it from the packing-case, and the customer's complaint was confirmed. The armature lead was taken off the starter, the arm moved on and off the first step, and the absence of any flash showed that there was a break in the field circuit. The armature lead was replaced, the field wire taken off and connected to the line terminal of the starter, thus placing the field across the main as soon as the switch was closed. On trying again, the motor ran perfectly, plainly showing the trouble to be in the starter itself. The closest inspection failed to show anything wrong, and in desperation it was decided to pull the starter to pieces and take the fittings off the slate. This ultimately showed the source of the trouble. The no-volt coil had its inner end connected to the iron core of the magnet with the object of cutting out the starting resistance from the field when the starter arm was full on. A brass set-screw went through the slate with the connection under the nut, and this set-screw, possibly owing to its having been tightened up too much, or being of hard brass, had broken in half in the centre of the slate, the connection on the back being stiff enough to hold it from dropping out.

ELECTRIC VEHICLE PROGRESS.

Electric Street Watering at Blackpool.—Blackpool is ever ready to adopt improvements, and has recently made a new venture by introducing an electric vehicle into municipal service. This takes the form of an electrically-propelled street watering tank wagon supplied by the General Vehicle Co., Ltd., of Imperial House, Kingsway, W.C.

Until recently, the work of watering the roads in Blackpool had been carried out by means of horse-drawn vehicles, which go a long way in a long time, whereas the new sprinkler can water a road 21 ft. wide, at a speed of 10 M.P.H., and recently, on test, distributed 6,000 gallons on 12 miles of road in 2¾ hours. This time included the running to the hydrant and loading, and from these figures, Mr. Bee, cleansing superintendent, Blackpool, estimates that he will be able to replace three or four of the horse-drawn vans. Apart from the great saving which this will mean to Blackpool, a great gain will be made in the expeditious manner in which the work will be carried out, which is highly desirable for a place like Blackpool during the season.

The tank, which has a capacity of 750 gallons, was supplied by Messrs. J. W. Glover & Sons, of Warwick, and is equipped with their patent Warwick sprinkler in the front of the vehicle, which arrangement enables the driver to exercise continual supervision over the spread of the water, and obviates the necessity of looking back.

The chassis itself is of standard G.V. pattern of 3½-ton capacity, fitted with 44-cell 17-plate Ironclad battery, which has an ampere-hour capacity of 268, and gives a range on one charge of 40 miles. It is understood that Mr. Bee, the cleansing superintendent, has made arrangements to charge this up at his destructor works.

Electric Street Watering Wagon at Blackpool.

The chassis frame is constructed of 5-in. channel steel; the motor is a G.E. totally-enclosed type; the controller is of the G.E. type having four speeds forward and two reverse, regulated by field coils. Transmission is by double reduction, first by Morse silent chain enclosed from motor to countershaft, second by roller chains from countershaft to rear wheels. The countershaft is of the housed type on Timken roller bearings with spur gear differential.

The vehicle complete looks smart, and has the usual advantages of the electric, namely, silence and cleanliness.

Electric Vehicles in U.S. Postal Service.—Mr. A. Jackson Marshall, secretary of the American Electric Vehicle Association, writing on the above subject, gives some interesting data regarding the performance and cost of delivery vehicles. This matter is of particular interest in the States, as the Government there is obtaining tenders for mail transport in 100 cities, while in this country there is obviously an enormous field for the use of the electric van in parcel delivery work, which has scarcely been touched, and in which the actual delivery cost per parcel is probably higher than it would be under electrical delivery conditions.

Two experimental parcel post journeys were made with a 1,000-lb. Walker truck, for delivery and collection of parcels respectively, the stops being accurately timed and other essential data being carefully compiled.

As regards the delivery run, 150 packages were delivered by 143 stops covering 46·3 miles in 6 hr. 23 min. The time taken in travelling and making delivery per stop was 2 min. 40·7 sec. Similarly the average travelling and delivery time per parcel was 2 min. 33⅕ sec., while the average stops per mile were 3·067. The cost per mile and per parcel for energy was ·55d. and ·17d. respectively.

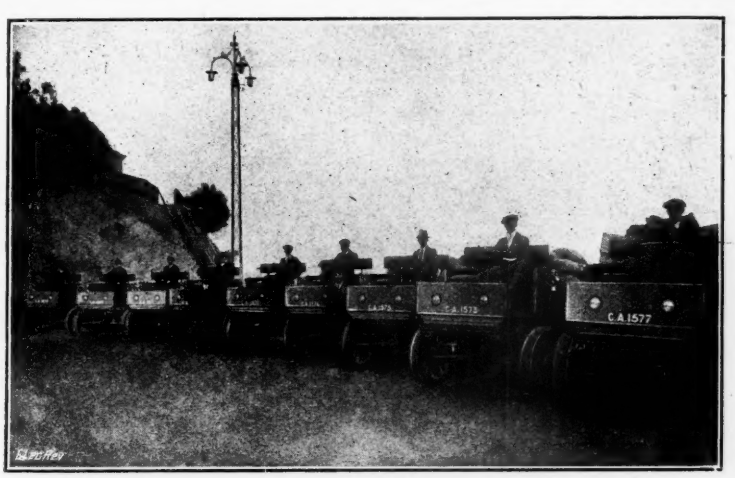
In the case of the collection run, 147 collections were made with 137 stops, covering 26·5 miles in 4 hr. 28 min.

The time taken in travelling and collecting per stop was 1 min. 57⅓ sec., and per collection 1 min. 49⅔ sec., while the average number of stops per mile was 5·17, and the cost per mile and per collection, of electrical energy was ·85d. and ·15d., current in both cases being figured at 1¾d. per unit.

The figures given are satisfactory so far as they go, but give little indication of the overall cost of delivery per parcel; fortunately many of the items which go to make up this cost can be filled in by those undertaking such work from known data.

Mr. Jackson Marshall believes that the motor vehicle must necessarily supersede the horse vehicle equipment in the U.S. postal service, and points out that in recent years 20 to 30 electrics have been used in New York city in the service, although, owing to changes in the system, only 12 are now in service, making deliveries from 19 postal substations of large and heavy packages sent through the parcel post. During one winter month in 27 days these machines travelled 7,111 miles, and delivered 98,243 parcels, an average distance of 22 miles per individual vehicle.

The machines have, however, capacities of 45 miles per charge. The deliveries average out at 303 per day per vehicle, and the average distance per packet at 382 ft., while the average cost per parcel, excluding the salary of the attendant who accompanied the truck and made the actual deliveries, was between 1½d. and 1¾d.



Electric Vehicles used by the South African Railways.

In addition to the above trucks, a number of heavy machines are used for mail haulage between New York city depôts and postal stations, and some have been in service five or six years, having been used 24 hours a day in the year during that period. Such mail service is considered to be one of the most exacting to which motor trucks can be applied.

The Indianapolis Post Office has used three electric delivery wagons which, in point of reliability, speed and mileage, have proved very satisfactory.

In a seven-hour day these wagons averaged 271·5 parcels in 189 stops over a distance of 18·75 miles. The cost of the day's run, not including the wages of the carrier, was about 23s.

The stops per mile were 6·02; cost per stop, 1·6d.; and cost per parcel, 1d.

Last year the Parcel Post Delivery Committee of the E.V.C. of America conducted an extensive campaign with all the U.S. Government officials at Washington, the postmasters generally throughout the country and others interested, with a view to inducing the Post Office authorities to recognise the value of the electric vehicle in their business. The work is so similar to that of the house-to-house delivery undertaken by large stores that their successful use by the many important American houses, should, it is considered, have considerable influence on the Post Office authorities. Mr. Jackson Marshall gives a list of large users of electric delivery vehicles, including the Ward Baking Co., with 510; the Adams Express Co., 326; the Marshall Field Co., 230; the American Express Co., 220; and several others, although these also employ numerous petrol-driven vans. For transport work over comparatively short distances, requiring frequent starting and stopping, the electric vehicle has proved its utility and economy, both in this country and the States, one writer estimating a saving of 25 per cent. on the cost of petrol delivery vans for such service. The range of delivery is such as will cover all city work and specified journeys beyond town limits.

While the publication of data regarding "frequent stop and start" service is useful, there appears to be considerable scope for a more extended investigation of the cost and limitations of the electric as compared with the petrol, steam and horse-drawn vehicle in this country. One writer, for instance, has stated that it is found that where the proportion of running time is low and the standing time high, the electric vehicle is the more suitable; this raises the question of the influence on cost per ton delivered of standing charges in the case of an expensive electric vehicle as compared with, say, a horse equipment, where the idle waiting time is a considerable proportion of the whole.

Many transport services involve such conditions, and the electric vehicle is peculiarly suited to undertake the work from many points of view, but comparative data is lacking as to influence of standing charges on the cost of delivery where lengthy periods of waiting nullify to a large extent the possible saving in expense while running.

We want a better idea of the service limitations of the electric apart from limitations of distance.

South African Railway "Electrics."—At the latter end of last year the South African Railways at Cape Town obtained nine 7,000-lb. electric lorries from the South African General Electric Co. for delivery work from the Cape Town docks. These vehicles are of standard G.V. type; the battery is underslung and supplies a G.E.C. motor, from which transmission is by Morse chain to a countershaft in which is incorporated the differential, and from sprockets on the countershaft by heavy side chains to the rear wheels. Timken roller-bearings are fitted to the wheels, and the tires are solid, with twin tires on the rear wheels; external contracting brakes are fitted on the countershaft and internal expanding brakes on the driving wheel sprockets.

The control gives four speeds forward and two reverse. Motor, differential and axles are high off the ground, and the battery cradle gives 14-in. clearance from the ground.

The S.A. Railway Administration has had extensive experience of electric traction for short distance haulage, and its adoption on so liberal a scale points to the conclusion that within the limitations indicated the "electric" has peculiar advantages of its own.

"Bottle Rays."—According to the *Times* of August 19th, the German wireless news circulated through German official wireless stations and received by the Wireless Press contained the following:—Prof. Goldstein has discovered a new kind of rays which he calls "Bottle Rays" because they are produced from Leyden jars. They belong to the same class as the X-rays, but are of different colour when exported to the same surroundings. The gases of the "Bottle Rays" are very long and variously shaped, and at their end seem to dissolve in forms like clouds or cascades.

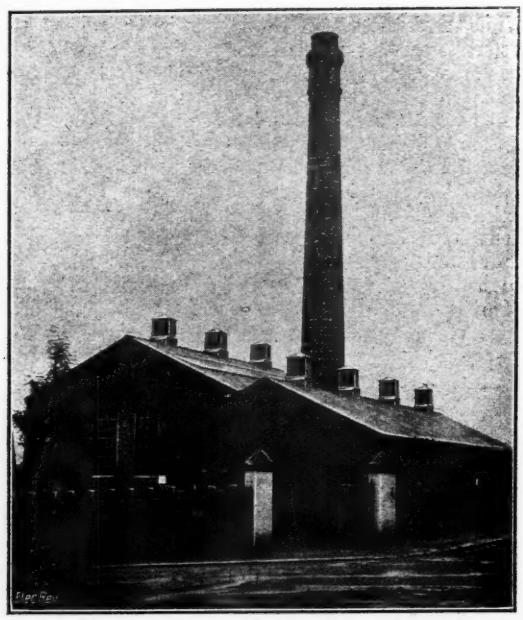
We are at a loss for an appropriate comment on this remarkable item of news, which leaves us dazed. We should be glad to know whether Prof. Goldstein did it into English, or whether the Wireless Press is responsible for the translation.

Horsham.—Plant Extension.—The Council has decided to arrange for the extension of the storage battery at the generating station in readiness for the winter load.

ILKLEY ELECTRICITY WORKS.

Some three weeks ago the electric supply undertaking of the Ilkley Urban District Council was officially inaugurated, Dr. Bates, chairman of the Council, performing the opening ceremony.

The Council purchased a Provisional Order for the area about 13 years ago, from a private firm, but as it did not take the necessary steps to utilise its powers, this order was



Ilkley Electricity Works.

revoked. A second Provisional Order was granted in 1912, and the question of evolving a suitable scheme came under consideration.

The idea of purchasing electricity in bulk from the West Yorkshire Electric Power Co., who were intending to erect a generating station at Bingley, was abandoned, the Council deciding to provide its own plant; a further proposal to utilise the water-power of the river was also discussed, but ultimately a steam-generating scheme, prepared by Mr. George Wilkinson, borough electrical engineer of the neighbouring town of Harrogate, was adopted, he being subsequently appointed consulting engineer to the Council.

The estimated cost of the work was rather under £18,000, and we gather that for that portion of the work the cost has not been exceeded; but additional cable extensions have been made, so that some £21,000 has been spent on the scheme.

The generating station, which has been erected in Little Lane, adjoining the Council's gasworks, is a plain brick structure, laid out suitably for extension, and includes a combined engine and boiler room—in which the "locomobile" type of prime mover is installed—with adjoining coal bunkers to hold 180 tons of coal, and an accumulator room.

The generating plant consists of two 200-h.p. locomobile sets, in which the engine is mounted directly over the boiler, and due to the high superheat and relatively small steam losses, some remarkable efficiencies were obtained on test at the works of the makers, Messrs. R. Garrett & Sons, Ltd.

The boiler is of the multitubular Cornish type, a special feature being that the corrugated furnace and tubes can be withdrawn as a whole for cleaning, &c.; at the end of the boiler is a tubular superheater chamber. The working steam-pressure is 190 lb., and 180° of superheat are added.

The engine, mounted over the boiler, is of the side-by-side compound type; the cylinder jackets are fed direct with boiler steam, and balanced piston valves are fitted to each cylinder. The engine is fitted with two fly-wheels and a shaft governor, and drives through a flexible coupling, an extension shaft carrying a chain sprocket, the drive on to the generator being by means of a Hans Renold chain running in an oil bath.

The engine exhausts into a jet-type condenser working in conjunction with a single Edwards-type air pump, the condensing water being passed through a sprinkler-type cooling plant outside.

The boiler is fitted with a special type of internal direct-contact feed water heater, water from which at high temperature is fed into the lower and cooler part of the boiler shell, thus improving the circulation.

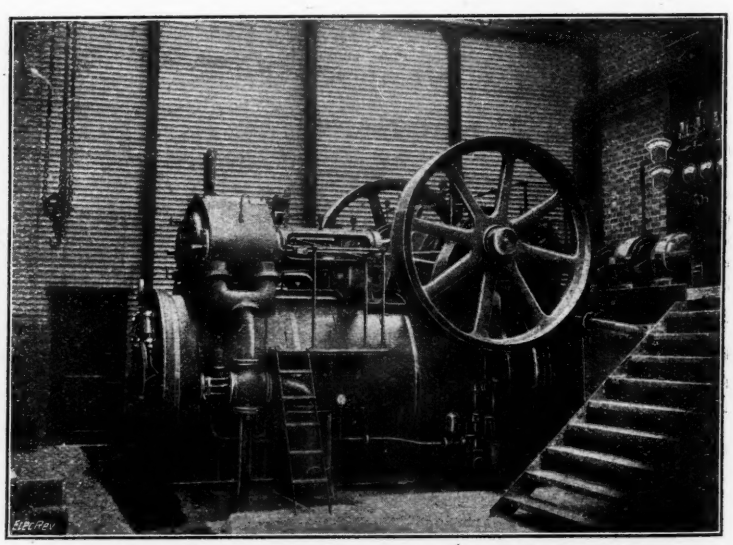
The engine runs at 170 r.p.m.; the test steam consumption was 10·6 lb. per b.h.p. on full load (180 b.h.p.), and the coal consumption, with high calorific fuel, 1·4 lb. per b.h.p. The mechanical efficiency of the unit is about 95 per cent.

The contract for the electrical generators, switchgear, &c., was carried out by the Phœnix Dynamo Mfg. Co., Ltd.; the main generators are 100-kw. units, and there are in addition two balancers and one double-ended booster to operate in conjunction with the battery plant.

The main switchboard was supplied by Messrs. Whipp and Bourne, as sub-contractors, and includes seven generator and works panels and four feeder panels for controlling the main feeders to Ben Rhydding, Middleton, the Town Hall, and King's Road, and from these points distribution cables are carried through all the principal streets and roads. The total length of cables laid is, approximately, 16 miles, and this work has been carried out by the Western Electric Co., Ltd. The distribution is on the three-wire system at 460 and 230 volts, motors above 1½ h.p. being supplied on the higher pressure.

About 50 consumers have been connected to the mains, and the prospects of superseding the private plants in the district are good.

It was at one time proposed to light some of the streets electrically, and also to illuminate West View Park with electric fairy lamps, but owing to the prevailing conditions this has been deferred.

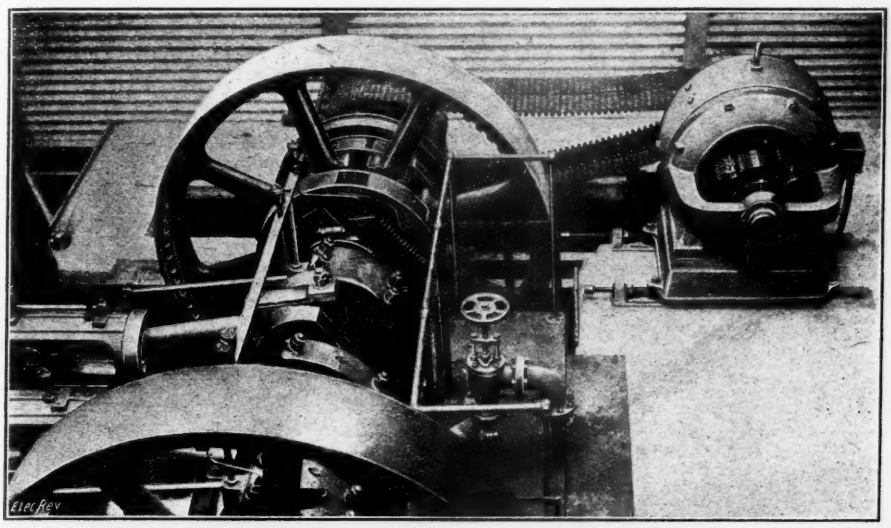


Garrett 200-b.h.p. Locomobile installed at Ilkley.

The charges for energy in Ilkley are 5d. per unit for lighting and 2d. per unit for power and heating purposes.

At the commencement of the work Mr. Wilkinson, junr., took charge of the cable laying as clerk of the works, but being on the reserve of officers, he was called up to serve with the first contingent of the Expeditionary Force, being subsequently wounded in the retreat from

Mons and taken prisoner. In October last his position as clerk of works was taken by Mr. Sydney H. Bill, who has since been appointed electrical engineer to the Council, as announced in a recent issue. There can be no doubt that a public supply of electricity will prove a valuable acquisition to Ilkley, and add to its numerous attractions as a health resort and residential centre; our congratulations



View of P.D.M. Generator and Chain Drive, Ilkley Electricity Works.

are due both to the consulting engineer, Mr. Geo. Wilkinson, and to Mr. Bill, the Council's electrical engineer, on the successful initiation of the scheme; to Mr. Bill our thanks are also due for material assistance in the preparation of this short description.

A NEW PRINTING TELEGRAPH SYSTEM.

(*Concluded from page* 232.)

The perforator, shown in fig. 1, is provided with a keyboard similar to that of a standard typewriter. The stroke of the keys is short, so that it can be operated without fatigue. Fig. 9 shows the interior of the apparatus. The selecting mechanism consists of five horizontal bars placed beneath the keys and so arranged that each key, when depressed, will engage one or more of the various bars and depress them. The depression of these bars selects the punches in the punch-head.

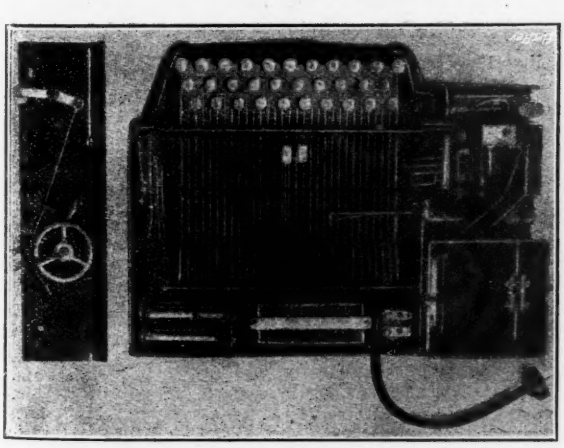


Fig. 9.—Keyboard Mechanism.

After the selection of the punches is made, a common contact is closed which operates the perforating magnet. The tape is perforated crosswise instead of lengthwise, thereby effecting a considerable saving in the amount of tape. This is illustrated by fig. 10, in which A represents the piece of tape required for transmitting the words "London, New York, Paris." One-half the tape shown in B is the tape required to send the same words by the Wheatstone. The two pieces shown in B represent the amount of paper used by a printing telegraph system which utilises the Continental Morse code. One tape is required for transmission, and the other is prepared by a receiving perforator and is then fed into a printing machine, which translates it and prints it on a tape. From this it will be appreciated that the economy in tape is a feature of some consideration. Fig. 9 also shows the mechanism of the indicator, the purpose of which is to indicate to the operator the number of letters that have been punched on one line. This is a ratchet mechanism which is operated one tooth for each operation of the punching mechanism, carries a pointer across a graduated scale, and is returned to normal at any time the carriage return key is depressed. A lamp signal is also provided which warns the operator that she is nearing the end of a line. This perforator is extremely fast and on test has perforated correctly up to a speed of 92 words per minute, which was the limiting speed of the operator.

Fig. 11 shows the transmitter with the tape inserted. At each revolution of the distributor, the tape is moved one step to the left. This is accomplished by means of a pulse of current from a segment in the local ring, No. 4, of fig. 6, as has already been described. The location of this segment is such that the stepping of the tape takes place shortly after the transmission from the fifth segment of the distributor, so that the tape can be moved forward and a new combination set up on the levers before the brush is ready to transmit another signal from this particular quadrant. Five fingers are raised which, if they find holes in the tape, move upward and operate levers which correspond to those shown in figs. 3 and 4, thus setting up in one quadrant or one group of five segments the necessary combination for a given signal. The transmitter is provided with two switches for control by the operator. The upper switch, which has two positions, "start" and "stop," is used when it is desired to insert a new tape or when it is desired to stop the transmitter. In the "start" position the tape is moved forward one step per revolution, as described. In the "stop" position the fingers which feel out the holes in the tape are all held down, thus connecting only the spacing battery to the five segments connected to this transmitter. The switch in the base, which has two positions, "on" and "off," opens and closes the circuit of the stepping magnet. If in the "off" position, the tape will therefore not be stepped forward, but the signal which happens to be in the transmitter will be repeated once for each revolution of the distributor, because the operation of this switch does not draw down the fingers which feel out the holes in the tape, as does the operation of the other switch. This is sometimes desirable for testing purposes. Normally, this switch is left in the "on" position. Fig. 13 shows the transmitter with the cover removed and the clips which are provided to make contact with springs mounted on the table. This method is adopted with the

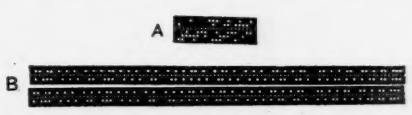


Fig. 10.—Comparison of Perforated Tapes.

various pieces of apparatus, as will be noted later, so that a piece of apparatus can be readily removed, if suspected of being faulty, and replaced by one which is known to be in working order.

The printer is shown in fig. 1. In front of the printer proper is a box containing the relays and resistances essential to its operation. A bell is also provided which responds to a predetermined signal sent over the line, this signal being the signal for "J" preceded by a figure-shift signal. Alongside of this box on the printer frame are two push-buttons, one marked "CR" and the other "LF." By operating these push-buttons, the operator can return the carriage or cause the paper to be moved upward. This is frequently desirable, particularly in starting up after an interruption, in preparing the printer for a new message. "CR" indicates "carriage return," and "LF" "line feed." The printer and the relay box are two separate units and are connected to the table wiring through spring clips similar to that shown on the

transmitter. The relay box is removed by pulling forward, and the printer by sliding backward. The printer is arranged to print the message in column form on paper 8.5 in. wide. Fig. 14 shows the form of message and style of characters. Paper is supplied to the machine from a roll mounted on the back, and so arranged that it can be readily replaced by an operator standing in front of the table. Just above the window of the printer is a cutting edge which permits a message to be torn off as soon as completed. The machine is of the type in which the paper moves and the type wheel is stationary, except for its rotary movement, in order to bring the desired letter opposite the paper. The type wheel is mounted on a vertical shaft driven by a spring which is kept under the desired torque by a small motor and dynamometer. The type shaft is released after the letter has been selected, and it revolves until it strikes a stop thrown up in its path. The position of the stop is determined by the letter selected and brings the desired letter in front of the paper. As soon as the type wheel is stopped the paper is forced against the type wheel by a printing magnet, and the letter is printed. The wheel is inked by two felt rollers which have been saturated with ink and which are held against the type wheel. The selection of stops is obtained mechanically by the use of five disks. The position of each disk is determined by an electromagnet which is under control of one of the relays connected to the receiving segments. For each combination of relays selected there is a corresponding movement of the disks which permits the required stop to be moved into such a position as to stop the type wheel in the proper position. Fig. 13 shows the printer and relay box with covers removed. The paper has also been removed, in order to show parts which would otherwise be hidden. The type wheel and ink rollers are shown at 1, the selecting disks at 2, and the motor at 3.

One unique feature in the design of this printer is its unit of construction. For example, the mechanism which moves the paper carriage and the paper across in front of the type wheel is a complete unit by itself, as is shown at 4. In case of trouble in this unit, it can be replaced in a very few minutes without disturbing the adjustments of the other units which go to make up the printer. The printing unit is shown at 5, and is likewise easily replaced. The paper carriage, 6, is a unit which can be readily removed. Likewise the paper lift, 7. In fact, the working parts of the printer consist of twelve units, each distinct and readily removed. Two lamps are provided for special signals, No. 8 and No. 9. Lamp No. 8 is used in the one-way system when the printer is used in connection with a keyboard, and indicates to the operator that she is nearing the end of the line. Signal lamp No. 9, used in all methods of operation, indicates whether or not signals are coming in to the printer. In all the methods of operation using a distributor, two-way, double-duplex, triple-duplex and quadruple-duplex, this lamp is operated directly from the distributor through the intermediate segments in the receiving ring R, (fig. 4). The flashing of this lamp when the printer is not working indicates that the latter is out of service.

The function of this lamp is to eliminate the possibility of an operator sending messages when the distant printer is not working and the receiving operator assuming that the failure to print is due to the fact that the transmitter at the distant end is not sending. In the relay box the five relays to the left constitute the five selecting relays shown in figs. 3 and 4. The sixth relay from the left is the one which receives a pulse from a segment in the local ring, No. 4, and starts the mechanism of the printer after the selection has been received by the selecting relays. The remaining seven relays are required to perform various functions, the description of which would lead to considerable detail.

Fig. 15 shows a piece of apparatus known as the automatic control. The function of this piece of apparatus is to stop the transmitter in case the operator is unable to keep up with the pace set by the distributor. Its position on the printing table is shown in fig. 1, directly behind the transmitter, the projecting lever arm extended forward between the perforator and the transmitter. The tape normally forms a small loop as shown. If the perforating operator should stop, the transmitter will continue until the slack in the tape is used up and the tension of the tape lifts the lever of the automatic control. This movement automatically stops the transmitter, which, however, continues to transmit only spacing current, having no effect on the distant printer. As soon as the operator begins perforating, the lever arm is dropped and the transmitter continues from the point of the interruption. Thus the message at the distant end is not mutilated. The automatic control has one other important feature, namely, it enables the receiving operator to send bell signals over the line, as has already been referred to. This is accomplished by an escapement mechanism which drives cams, causing certain spring combinations to be made in sequence. For example, to ring the bell once at the distant end, the operator will insert a finger in the hole marked "start" and pull down until the finger engages the stop, and then release. In returning to the normal position shown the cams will be rotated and the required contacts made to give the bell at the distant end one stroke. In doing this the transmitter is automatically stopped and started, thus causing no mutilation of the message which is being transmitted. If it is desired to ring the bell twice at the distant end, indicating to the operator that the tape should be re-run, the operator will insert the finger in the second hole marked "re-run," pull the lever down to the stop and release as before, and so on. Thus signals of one, two, three, four or five strokes of the bell can be automatically transmitted over the line without mutilating the message that is being transmitted. The automatic control is also arranged with the clip connections, so that it can be readily removed. Fig. 15 shows the interior of the apparatus, the cams and contact springs being plainly visible in the foreground.

Fig. 1 shows a complete multiplex table equipment. On the left is the printer with its relay box, in the centre are the transmitter and automatic control, and at the right is the keyboard perforator. Beneath the table at the left will be noted a metal terminal box. This box contains fuses, and in it all the connections are made between the table and the distributor. This table is a standard unit for use in the two-

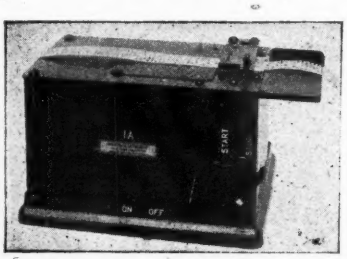


Fig. 11.—Tape-operated Transmitter.

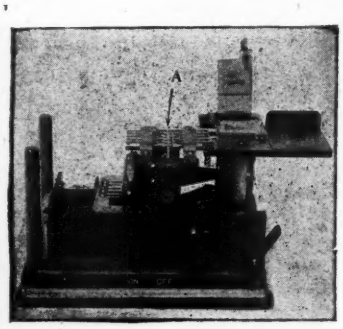


Fig. 12.—Transmitter with Cover Removed.

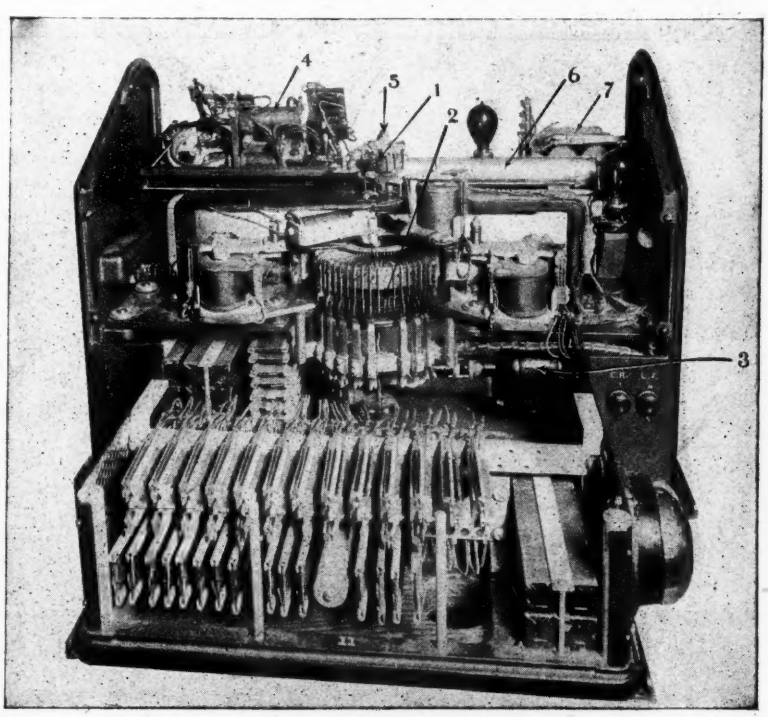


Fig. 13.—Interior of Printer and Relay.

way, double-duplex, triple-duplex, and quadruple-duplex methods of operation. The number of table units required for the various methods of operation are as follows: Two-way, one at each end; double-duplex, two at each end; triple-duplex, three at each end; quadruple-duplex, four at each end.

In addition to the number of table units required for each method of operation, there will be required at each end an electrically driven tuning fork, a motor, a mechanical corrector, and a distributor having the proper segment arrangement for the particular service required.

For the one-way service using keyboard transmission the same printer as shown in figs. 1 and 13, without the relay box, is mounted on a special table with a direct transmitting keyboard, this combination sometimes being called the short-

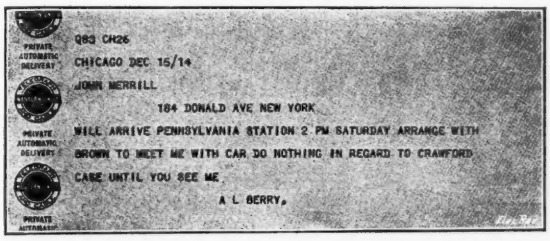

Q83 CH26
CHICAGO DEC 15/14
JOHN MERRILL
184 DONALD AVE NEW YORK
WILL ARRIVE PENNSYLVANIA STATION 2 PM SATURDAY ARRANGE WITH
BROWN TO MEET ME WITH CAR DO NOTHING IN REGARD TO CRAWFORD
CASE UNTIL YOU SEE ME
A L BERRY,

Fig. 14.—Message Printed as Received.

line printer. Where the characteristics of the line will permit, the one-way system is capable of satisfactory operation at the highest operator speeds. On more difficult circuits it may be advisable to resort to tape transmission, for reasons already stated. Where this method of operation is used as a feeder or distributor for one of the other methods of operation, it may be advisable to use tape transmission at the central-office end, since then it will be possible to utilise tape produced by a re-perforator for transmission purposes. In this case it is not essential to have the printer at the central office record outgoing messages, since the tape may constitute an office record.

The practicability of the system has been proved by tests of the quadruple-duplex by the Western Union Telegraph Co.

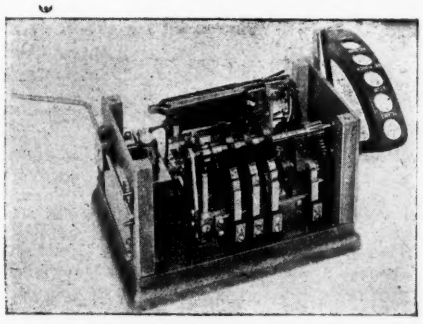


Fig. 15.—Interior of Automatic Controller.

This equipment has been in operation for more than a year. The results of this and other less extended tests indicate that the system is thoroughly practical and is well past the experimental stage.

The success achieved is the result of the concentration on a single problem of a number of minds, each particularly well equipped with knowledge and experience for the consideration of some important phase of the problem. Nor has the work of earlier investigators been neglected. The multiplex principle of Baudot and the five-unit code used by him over 30 years ago form the foundation of the system.

It remained, none the less, for Mr. Donald Murray, who had previously developed a high-speed system using the Baudot five-unit code, to appreciate the inherent advantages of the Baudot multiplex system. This he incorporated in the Murray multiplex system, which included machine sending and column printing. Although novel in many respects, the system described is not altogether an innovation, but is rather the realisation and working out of old principles which have been tried and found successful.

Mexico.—The Commercial Intelligence Branch of the Board of Trade has received the following telegram from His Majesty's Consul at Mexico City:—"Communications restored (with) Vera Cruz by rail. In my opinion it will be preferable to defer shipments (of) British merchandise for the present except by advice of agents here. Communications interrupted between here and Northern frontier still."

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Multi-Pole Isolating Switches.

It often occurs in modern practice that it is preferable to install multi-pole rather than single-pole isolating switches; it is, for example, sometimes difficult to mount the ordinary hook-operated single-pole type where they can be easily and quickly reached by the hook, and for such cases a multi-pole switch, such as shown in fig. 1, will be found particularly useful. It will be noted that

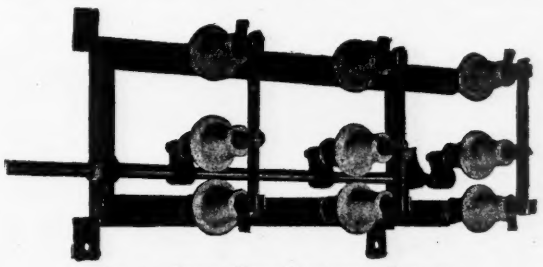


Fig. 1.—Multi-Pole Isolating Switch.

this switch is provided with a spindle on which may be mounted a chain-wheel or crank for any system of mechanical romote control, by means of which the three poles may be switched in or out immediately with certainty and ease. These switches are supplied by the Electric and General Works, Ltd., of 15, Victoria Street, London, S.W., for any voltage up to 50,000.

Condenser Protection against Surges.

The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., recently issued an illustrated brochure giving a full account of the condenser system of protecting electrical networks, &c., against the effects of surges. These phenomena were practically unknown or, at any rate, unrecognised, until, with the growth of electrical undertakings, the amount of energy stored in long over-

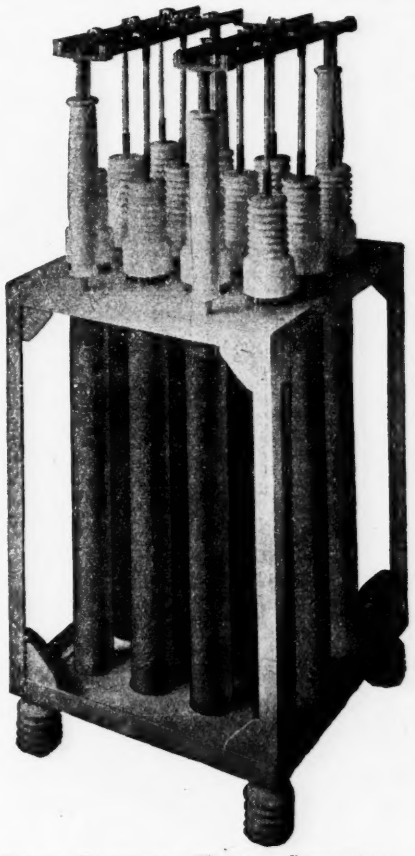


Fig. 2.—Battery of Mosciski Condensers.

head or underground cables became sufficiently great to allow of surges which imperilled the integrity of the insulation or actually broke it done. Such surges may be due to resonance, switching operations, arcs and sparks, and lightning discharges, and differ in their nature according to their origin, but any kind of surge is capable of producing severe stresses on the insulation of a system

at some point or other. The horn type of arrester is useless except for high voltages, and as its use involves the formation and rupture of an arc, its disadvantages may outweigh its advantages. The aluminium electrolytic arrester is excellent for use with direct current, but cannot be used on A.C. lines without a spark-gap in series with it, and has to be charged daily. Multi-gap arresters have been widely and successfully installed, but will not operate at low voltage, and are easily put out of action by a discharge, leaving the system unprotected. The presence of a high resistance in series with the surge arrester, which is necessary to prevent the possibility of resonance, also limits the effectiveness of the arrester in reducing the surge voltage. From all these objections the condenser type of arrester is free; it offers a high impedance to line voltages of normal frequency, while it practically short-circuits the line for high-frequency surges, and dissipates the energy of the surge without allowing a heavy line current to flow to earth. It is connected directly to the line, without any spark-gap, and thus is in a position to act instantaneously and at all voltages, and has the important advantage that it modifies the wave-form of steep-fronted waves, which are apt to break down the end turns of transformers and generators. All these points are discussed in the brochure, which, as a technical essay, is of quite exceptional quality, and illustrations are given of the Moscicki condensers in various applications.

This device has been previously described in our pages; briefly, it consists of a long narrow glass tube, coated with metal inside and out; at the neck, where the static stress is greatest, the glass is thick, but elsewhere it is very thin, so that the capacity is great. A china insulator surrounds the neck, and the whole is mounted in an iron tube, filled up with a mixture of water and glycerine, to maintain the temperature uniform. These elements are grouped together in frames to form batteries of suitable capacities, of which one is shown in fig. 2, for indoor use; fig. 3 shows a battery for installation out of doors, with an iron cover. As the condenser alone cannot deal with high-pressure, low-frequency discharges, the Giles valve is employed for this purpose; it consists of a spark-gap in series with a resistance, and with a number of spark-gaps, each of which is shunted by a condenser to earth. This device, owing to the use of condensers, begins to act with much smaller excess pressures than ordinary multigap arresters. Other apparatus dealt with in the brochure are the water-jet resistance for relieving lines of static charges; electrolytic condenser batteries, for protecting D.C. tramcars, and disconnecting switches for condenser batteries. Fig. 4 shows a battery of four electrolytic condensers, for use on a circuit up to 600 volts, and fig. 5 is a section of the D.C. arrester, which consists of two

Fig. 3.—Outdoor Type of Condenser.

Fig. 4.—Battery of Electrolytic Condensers for Tramcar Protection.

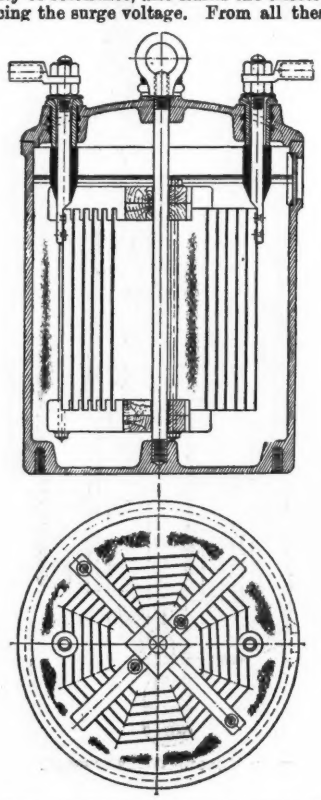


Fig. 5.—Section Through Electrolytic (D.C.) Condenser.

Fig. 6.—"D.G." Four-Heat Griller and Cooker (see p. 267).

aluminium plates wound in coaxial spirals and immersed in an electrolyte. Illustrations of large installations of condensers are also given in the brochure, and technical explanations, diagrams of connections, &c., are included. It is certainly an admirable specimen of trade literature.

The "D.G." Four-Heat Griller and Cooker.

Messrs. Drake & Gorham, of 66, Victoria Street, S.W., are placing on the market a new pattern of griller and cooker made in nickelled steel, and consisting of a 7½-in. diam. circular open-type heater, supported on brackets above a 9-in. diam. base; grilling and toasting operations are carried out on the underside, and boiling and frying above, a full complement of utensils, including shallow and deep pans, strainer and reflector or lid, being provided for this purpose, as shown in fig. 6 (page 266).

The feature of the apparatus which will appeal to purchasers is that by connecting up to specified pairs of the four plugs provided, four heat variations can be obtained, thus enabling only the necessary amount of heat (and electrical energy) to be used for a particular purpose. The four loadings are 600, 330, 270 and 140 watts. This arrangement, besides facilitating cooking operations, means a considerable saving in cost of current in many cases.

The construction of the heater unit is simple and robust, and it appears to be easily repairable.

The apparatus is connected to the mains by means of flexible with twin sockets; it appears to be excellently finished, and as it costs considerably under 30s., its cost is quite moderate.

AN ELECTROMAGNETIC VACUUM BALANCE.

By JOHN S. ANDERSON, M.A., B.Sc., Ph.D.

(*Abstract of paper read before the* Faraday Society.)

During the course of work carried out by the author on the rates of absorption and giving up of water, alcohol, and benzene vapours by a gel of silicic acid, an electromagnetic balance was designed to allow of substances being weighed *in vacuo*. The chief aim was to be able, if possible, to weigh a substance, whose weight may alter under certain conditions, from time to time without removing it from the vacuum. The principle involved is that of the well-known Kelvin balance for "weighing" electrical currents. One of the scale-pans of an ordinary balance is replaced by a circular coil of wire whose axis is vertical. This coil is movable between two larger fixed coils of wire, which have the same vertical axis. The three coils are so connected that an electrical current may be passed through them in series, through the movable coil and the lower fixed coil in one direction and through the upper fixed coil in the opposite direction. Thus when an electrical current is passed through the coils, the movable one is attracted towards the lower, and repulsed by the upper, fixed coil. These attractive and repulsive forces may be increased or decreased by increasing or decreasing the current passing through the coils; they are made use of to counterbalance the force of gravity acting on the substance to be weighed in the scale-pan hanging from the other end of the beam of the balance. Should the weight of the substance vary from time to time, the variations can be determined by altering the current passing through the coils until equality of the forces acting on either end of the balance beam is obtained. The balance is enclosed in a bell-jar which can be evacuated, so that the process of weighing can be carried out while the substance whose weight is required is in a vacuum.

The chief metallic parts are nickel-plated. The movable coil of wire which takes the place of the second scale-pan hangs halfway between the fixed coils of wire and when the beam is at rest, that is, when the pointer is at zero. The knife-edge at the centre of the beam rests on a small plate of agate. The balance is fixed to a round glass plate which lies on a steel table having three legs. This table rests on a wooden board, to which are attached three screws, the height of which may be varied at will. By adjusting the screws the plate on which the balance rests may be fixed in a horizontal position. The dimensions of the movable parts of the balance are such that the total surface exposed on either side of the beam is approximately the same. The reason for this is that when in an experiment water vapour, or other vapour, is introduced into the balance, there will be approximately the same amount of vapour adsorbed by the metal, glass, &c., on either side of the beam.

The method of connecting up the coils of wire B, B′, and B″, fig. 1, with one another and with the necessary battery is as follows: Two brass terminals F′ and F″ pass through small holes in the glass plate. In order to prevent leakage of air at the terminals when the bell-jar cover is on the balance and the apparatus is evacuated, small leather washers are provided above the plate, and the terminals are sealed below the plate by means of wax. A little rectangular box of ebonite is fixed at the top of the pointer, and is divided into two compartments, each containing a little mercury. Above the box, and attached in a horizontal position to the centre of the beam, is a small rod of ivory. Two small pieces of platinum passing through this rod are fixed vertically in such a position that each of them dips into one of the mercury compartments of the box. When the beam vibrates about its position of equilibrium the pieces of platinum move through the mercury, but friction is reduced to a minimum owing to the fact that the lower ends of the platinum pieces are very fine and are slightly flattened in the planes of motion. On the end of the balance beam from which the coil B hangs is fixed another small ivory rod. Two very fine wires are stretched from the pieces of platinum over this rod and pass down in the form of spirals to the two ends of the movable coil B. Wires connect the terminal F′ and one of the compartments of the box, the terminal F″ and the coil B″, the coil B″ and the coil B′, the coil B′ and the other compartment of the box. Thus there are electrical connections from the terminal F′ through the mercury in one of the compartments, the piece of platinum and the wire to the coil B and back through the wire, piece of platinum and mercury in the other compartment to the coil B′, and thence through the coil B″ to the terminal F″.

When the balance is not in use the beam rests on the framework. An electrical method is used for releasing and fixing the beam. The outer end of a lever at the back of the balance is connected above and below by two metal pieces to two cylindrical iron rods, which can move freely in a vertical direction inside two solenoids O′, O″ fixed to the central upright stem of the balance. When a current of electricity is passed through the coil of the lower solenoid O″ its iron core is drawn down into the solenoid. Thus the outer end of the lever is drawn downwards, allowing the framework which is connected to it to fall down a short distance, the balance beam being thus released. The weight of the cores causes the lever to remain down when the current is switched off. When an electrical current is now passed through the coil of the upper solenoid O′ its iron core is drawn upwards. This action causes the outer end of the lever to rise, thus raising the framework. The beam is therefore held fixed at rest again. A wire spring holds up the lever when the current is switched off. Thus in order to release or fix the beam of the balance, a current of electricity need only be momentarily passed through the lower or the upper solenoid.

Three wires, insulated from one another by means of ebonite, pass through the metal base of the balance and through the glass plate. They end below the steel table in three terminals P, P′ and P″. One end of the coil of wire in the solenoid O′ is connected to the terminal P′, one end of the coil in the solenoid O″ is connected to the terminal P″, while the other ends of the coils are both connected to the middle terminal P.

The electrical connections necessary for operating the balance are shown diagrammatically in fig. 1. The connections below F′ and F″ are all outside the balance; the others have already been

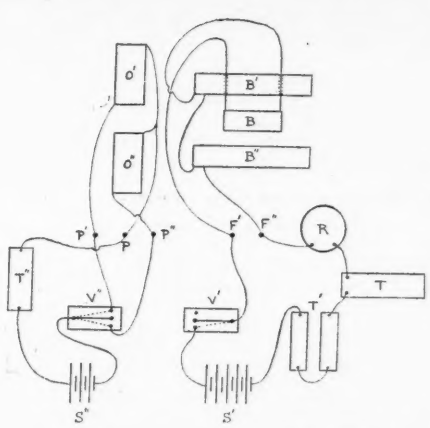


Fig. 1.—Diagram of Connections.

described. R is an amperemeter for measuring the current passing through the coils. The battery S′ gives a pressure of about 70 volts. T is a resistance box, and T′ represents two slide resistances connected in series. V′ is a key by means of which the circuit may be made or broken at will. To the left are shown the connections necessary for releasing and fixing the balance beam by means of the lever operated on by the solenoids O′ and O″ and their iron cores. The battery S″ gives a pressure of about 10 volts. T″ is a slide resistance. V″ is a two-way key; when the lever is placed in the upper position (dotted line), the circuit through the upper solenoid O′ is closed, and when placed in the lower position (dotted line) the circuit through the lower solenoid O″ is closed. When the lever is in the middle position no current passes through either circuit.

The balance should be carefully calibrated before and after a series of experiments. This may be done by placing certain known weights in the scale-pan of the balance and determining the strengths of the currents that must be passed through the coils in each case. A curve may then be constructed, giving the relation of electrical current to weight.

With the amperemeter used in the experiments a difference of 0·1 milliampere could be detected. This corresponds to a difference in weight of 0·35 to 0·7 milligram, depending on the portion of the range of weights used. If more care were to be taken in choosing the range of weights, and if a more accurate amperemeter were employed, it would be possible to increase the sensitiveness of the balance considerably. It is advisable to determine approximately before an experiment what the total variation in weight of the substance under examination will be, so that a convenient range of current may be employed. The maximum

current applied should be kept fairly small, in order to prevent heating of the coils.

There are numerous physical and chemical processes which may be investigated with the help of the balance.

ELECTRICAL HOUSES AT DUMBRECK, GLASGOW.

Electricity offers such advantages in cleanliness, convenience and comfort that it is not surprising to find it daily growing in favour with the modern housewife. Particularly when applied to cooking and heating it eliminates much of the drudgery from the home besides possessing undoubted hygienic properties.

An electrical garden city fittingly describes the latest development in the form of a number of neat and compact villas erected on a charming little estate called "Hazlewood," situated at Dumbreck, a comfortable car journey from the centre of the City of Glasgow.

According to Mr. Lackie, chief electrical engineer of the city, these are the first houses where domestic requirements are entirely dependent upon the electric power.

These villas, which have been erected by Messrs. Geo. Hamilton and Co., of Glasgow, are built in several sizes of four, five, and six

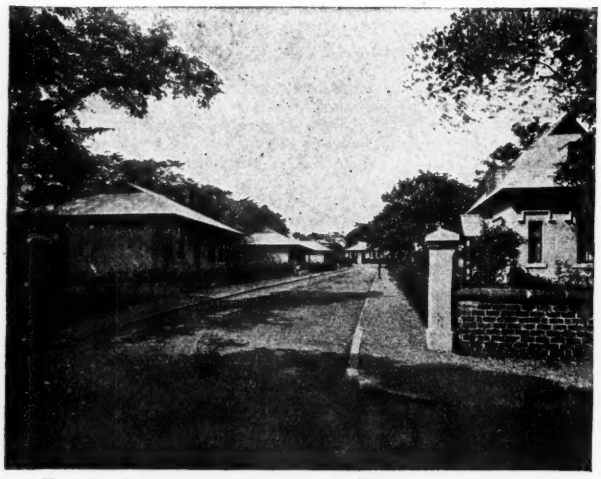


Fig. 1.—One of the Avenues at "Hazlewood" Estate, Dumbreck, near Glasgow.

apartments, and present a most picturesque appearance against the thick foliage of the trees, with which the estate abounds.

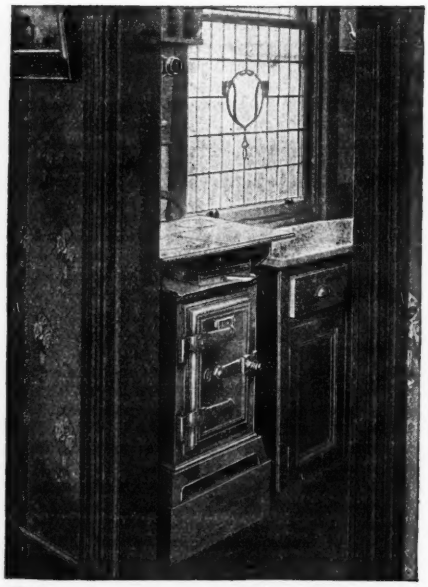


Fig. 2.—Kitchen of one of the Model Homes at "Hazlewood" Estate, Dumbreck, showing a Carron Electric Cooker.

The fires in the principal rooms, particularly the drawing rooms, were supplied by the Carron Company, and comprise several of that company's newest types.

These fires give a rich red glow of heat almost as much like the natural fire as one could wish. The standardised elements, with which they are fitted, are easily interchangeable. Guard tumbler

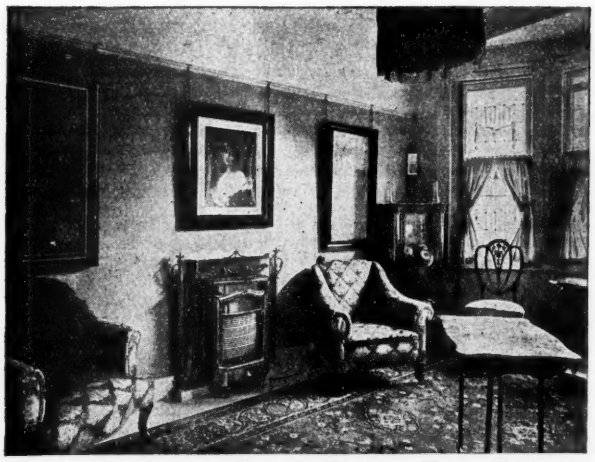


Fig. 3.—Corner of a Drawing Room in Model Home at "Hazlewood" Estate, Dumbreck, showing a Carron Electric Fire.

switches and earthing terminals are also provided. This type of fire is most reliable in action, portable, and inexpensive in first cost and maintenance, and, being artistic in design, considerably adds to the decorative effect of the room.

The cookers, which are by the same firm, embrace their popular Nos. 304 and 305 types.

The ovens in these cookers are double-cased and packed with heat-retaining material, the exteriors being of moss-green porcelain enamelled steel sheets. The interiors are mottled white and gray porcelain enamel lined, the raised parts, including the hob—which is fitted with boiling plates and grill complete—are ground and polished, and all heating elements are standardised and removable. Indicating switches, fuses and pilot lamps are supplied to each cooker, the pilot lamps indicating at a glance whether the current is on or off, thus avoiding waste of electrical energy.

Hot-water heaters are placed in the bath-rooms immediately over the taps, and, being near the delivery, loss of heat by long pipes is obviated.

As some indication of the economy and efficiency of electric cooking, it might be mentioned that a breakfast can be prepared and served in the time usually required to make up a coal fire, and according to tests taken by Mr. Hamilton during the month of June, the cost for cooking, lighting and heating for six persons worked out at 8d. per person per week.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Staff Engineers and Labour Exchanges.

With reference to your correspondent's letter on the above subject in your last issue, I would inform you of my own experience.

A few weeks ago I made an application for a post for which I thought my training and experience would be useful. I handed my letter of application, together with copies of testimonials, &c., to the clerk in charge at one of the Exchanges. My letter, &c., was returned to me with a card which I was requested to fill in. This I declined to do, and consequently my application was void.

I have heard from friends that they have been deterred from applying for posts owing to these conditions.

Surely, without in any way being guilty of snobbishness, some discrimination should be exercised at the Labour Exchanges between the inquiry for a job from a casual labourer and the application for a staff appointment from a trained and educated engineer.

I am quite certain that inquirers are being deprived of the replies from the best men, and applicants are discouraged from further attempts by the methods now in vogue.

Staff.

London, S.W., *August 20th*, 1915.

With reference to "Alcor's" letter in the Electrical Review of August 20th, I should like to inform staff engineers, and, indeed, all employés working for a salary, in distinction to "workmen" paid by the hour, that they are at liberty to seek and accept any position they like. This also applies to those working on war munitions. In this connection I would quote from a letter from the Ministry of Munitions, now before me, in reply to a communication as to

whether salaried employés were entitled to a war bonus when employed on "munition" work, and also if they were at liberty to seek other employment. This letter reads as follows:—

"In reply, I am to state as regards the first point, that the matter is one to be settled with your employers, and as regards the second point, that the Munitions of War Act, 1915, imposes no restriction in this respect on employés other than workmen in regard to changing employment."

This extract makes the position of salaried employés quite clear, I think.

Salary.

London, *August 21st*, 1915.

Units from Refuse.

It would be very interesting to have the opinions of refuse destructor engineers on the point so strongly raised by Mr. Abraham, namely, the setting of the boiler directly in the combustion chamber, next to the grates themselves.

At first sight, it would undoubtedly appear to be an advantage, but I am of opinion that in actual running there would be no real gain. It seems that the great secret of efficient destruction of the refuse—and by efficient I mean freedom from noxious fumes, dust, &c.—is the provision of an adequate space in which all fumes can be thoroughly cremated, and ample room provided for the settlement of dust. To do so the fumes must, therefore, be brought into intimate contact with the red-hot surface, and by placing the boiler tubes on the top of the combustion chamber, a certain amount of red-hot surface is displaced by the cooler surface of the metal tubes. Further, the excellent steaming results we obtain are undoubtedly due to the large thermal storage system provided by the red-hot brickwork of the combustion chamber, as well as the brickwork of the boiler setting. It is well known that the great efficiency of mechanical stoking is largely due to the fact that no cold air is allowed to enter the boiler setting during the process of stoking. If the boiler tubes were set immediately over the combustion chamber of a destructor there would indisputably be much more chance of cold air getting to the tubes when clinkering a fire. In our type of destructor, even when steaming on a good load, there is no appreciable drop in the pressure when clinkering, and this is no doubt due to the equalising effect of the large heat storage in the brickwork chamber lying between the grates and the boiler setting.

I have experimented with burning cheap dust coal mixed with the refuse, and it certainly is a great help, but my experience has proved that it does not pay us, owing to the cost of carriage between the pits and our works, which, in our case, amounts to something like 12s. per ton.

I quite appreciate Mr. Abraham's remarks about the price of house coal in Wales, but what I meant to imply was that I was under the impression that the miners were able to obtain a certain amount of coal at a very cheap rate for home consumption, hence there would not be the drastic economy exercised in the houses with regard to the burning of kitchen fire cinders.

I hope these points raised by Mr. Abraham and myself will induce destructor builders to enter into the question more seriously, because, as I have already stated, under the present prices of coal, it behoves us all to exercise all our engineering ingenuity in utilising every source of heat possible. We at Horsham are burning saw-mill refuse on the coal grates of our boilers without any special re-arrangement of the fire-bars, with every success.

John B. Morgan,
Electrical Engineer.

Horsham Electricity Works,
August 23rd, 1915.

From the Dardanelles.

A few lines to thank you for your continued kindness in sending out the copies of the good old REVIEW for the information of electrical readers in the Royal Naval Divisional Engineers—the unit which, as you will probably remember, the Institutions of Civil, Electrical and Mechanical Engineers were instrumental in recruiting in September and October last. It enables the fellows to keep in touch with the commercial and scientific world, which would be difficult, if not impossible, in any other way, so that when that long-looked-forward-to day of returning to civil life arrives, we shall not feel so awfully strange and ignorant of all that has transpired during our absence.

[The writer proceeds to give a short diary of the work of the unit from March 1st to May 6th.]

From the latter date down to the time of writing we have been in every advance, engaged chiefly on construction and improvement of fire trenches and communication trenches, roads, pumped and gravity water supplies, bomb-proof dug-outs for hospitals, wire entanglements, redoubts, and similar things, so that many members of the Institutions who joined, thinking that their technical and scientific knowledge would be used, now subscribe themselves M.Inst.M.S., which, being translated, reads:—Member of the Institution of Muck Shifters, the coat of arms of the said Institution being a pick and shovel rampant!

Ten of the fellows names have already been published in orders for special zeal and devotion to duty, and we have yet hopes of netting some D.C.M.'s or D.S.O.'s. Forbes Jackson, of the B.T.H. Co.'s railway department at Rugby, who joined the R.N.D. as seaman and transferred to the unit as sapper, subsequently becoming Sergeant, is now Lieutenant. Stuart Aynsworth, of the Great Central Railway Co.'s electrical staff, is now a Corporal. G. Spittle, of the Great Western Railway Co.'s electrical staff Railway Smith's Department), is major and O.C. signals. The writer, who joined the Old Public Schools and University Men's Team as a private, subsequently transferring to the unit as sapper, was promoted, on July 7th, from lieutenant to captain.

One or two of us feel that, although we are doing our best out here, yet, as trained mechanical and electrical engineers, we should do more useful things on the manufacture of shells, for, after all, muck-shifting takes about two months, and skilled mechanic's work years, to learn; but I suppose this is the British way—muddle through and get there by sheer weight of £ s. d., men and munitions.

Again, with many thanks for your generosity.

M.Inst.M.S.

Royal Naval Divisional Engineers,
British Mediterranean Expeditionary Force,
c/o G.P.O., London, *August 6th*, 1915.

WAR ITEMS.

The Copper Reserves of Germany.—An official statement has been published in Germany regarding the stocks of copper existing in the country and the requirements of the military authorities. The statement is intended for domestic consumption, and very probably also for the information of other nations. Nevertheless, it deserves attention at the present time. The Teutonic commercial metal companies estimate that the stocks—which are held to include all copper that has been worked up into manufactures in past years—will meet the army needs for a long time to come, quite apart from the native production of copper, which is declared to have been largely increased since August, 1914. It is calculated that copper contained in manufactures exceeds 2,000,000 tons, or a tonnage sufficient for a war of 10 years' duration. A certain quantity of the metal is in use for domestic utensils and roofing purposes, but the greatest tonnage is to be found in industry and trade, particularly in electrical engineering. The former is readily accessible, but the latter is not in the same situation, and it has therefore been decided to collect statistics on the subject.

The collection of copper will present no obstacles in establishments which may be at a standstill, and where copper appliances seem at present to be superfluous, as the full value will be paid for the metal. In other cases, and in order to prevent disturbance in the economic life, it is proposed only to take the copper manufactures when substitutes are simultaneously provided as by the use of another metal (iron or zinc wire in place of copper, iron or steel in lieu of copper distilling appliances, &c.), or by making alterations in working as by increasing the working pressure in electrical mains, the change over from direct current to three-phase current, the linking up of different generating stations, &c. It is therefore considered that with the application of technical knowledge, combined with self-sacrifice on the part of the population and of industrial establishments, it will be possible to supply the army authorities with all the copper requisite for any period over which the war may extend.

If we turn to the international metal statistics which have been issued for many years past by a Frankfort company, it is shown that the consumption of copper in Germany amounted to 225,000 tons in round figures in 1911, 231,000 tons in 1912, and 259,000 tons in 1913, whilst the figures for 1914 are now stated to have equalled the combined consumption of Great Britain and France, which was 244,000 metric tons in 1913, and was probably higher last year. Now, if Germany has annually exported, say, 60 000 tons of copper in manufactures, and has utilised a similar tonnage in the production of munitions of war, it seems quite possible that the stocks or, rather, the internal resources of copper, in copper goods and in manufactures in which copper has been used, may amount to 2,000,000 tons. Certainly the copper cables and overhead conductors for lighting and tramway purposes, together with the plant in the numerous generating stations which have been erected during the past 20 years, must represent a considerable proportion of this tonnage. The native production of copper, which was 38,900 tons in 1912, rose to 41,100 tons last year, and is said to have been largely increased, but the latter assertion may be taken for what it is worth for the comparatively short period concerned. In addition, the Germans found large stocks of copper in Antwerp, which were appropriated.

The requisitioning of domestic copper utensils, and of industrial copper articles, brass and nickel, in Germany, appears to suggest that the resources of Belgium, and of that portion of the North of France in enemy occupation, have been exhausted, in the same manner as all machinery and plant, iron ore, and iron and steel likely to be of use to German firms in the manufacture of munitions of war, have been removed from Belgium and France to Germany. It is, however, impossible to say whether these appropriations include the copper consumed in the Belgian and Northern French electrical industries during the present century. At any rate, we think that, regarded from the standpoint of the great tonnage of copper consumed in Germany's home industries in the past 15 or 20 years, the idea that the country does not possess ample reserves of copper for a long time forward may be dismissed on the ground of having no foundation in fact, provided that the dismantling of electrical plant and installations is proceeded with, although there is no present intention of adopting a measure of this kind. At the same time there is no doubt that a considerable tonnage of copper reached the country through

neutral nations until two or three months ago, and thus strengthened the resources of the enemy.

The War and Trade Movements Abroad.—We read in the *Financial Times* that the French Mission to South America arrived at Bordeaux on August 16th. The aim of the journey was the development of commercial, maritime, and financial relations between France and the Republics of South America, and to protect French interests in countries where the untiring German propaganda had gained some success. A Franco-Argentine Committee was appointed in Buenos Ayres. M. Baudin, a former Minister of Marine, gave an account of the immense resources of Argentina. In regard to the territory hitherto known as German South-West Africa, both the Standard Bank of South Africa and the National Bank of South Africa announce the opening of branches at Windhuk, the capital. The same financial contemporary also quotes the annual report of the Committee of the British Chamber of Commerce for Spain emphasising the desirability of some old-established British foreign banking concern opening an establishment in Barcelona and Madrid or Bilbao, "in order to deal with the large volume of banking business which . . . . would at once be passed through its hands." Without such a branch British business is placed at a serious disadvantage. The matter seems to be of particular importance looking to the future when we remember that the German hold on electrical business in Spain was largely due to the efforts of German electro-financial-industrial organisations. If those organisations are weakened, as they well may be, as an effect of the war, the need for British banking organisations there will be greater than they are even now.

The Royal Society's War Register.—The Royal Society is compiling a register of scientific and technical men in Great Britain and Ireland, who are willing to give their services in connection with the war. The Register is classified into subjects, and will ultimately constitute a large panel of men of standing, whose services will be available whenever any Government Department or similar authority requires specialist assistance. The Register is being co-ordinated with those independently compiled by other societies and institutions, but the Royal Society would be glad to have applications for forms from such members of the staffs of colleges and technical institutions as have not yet been registered by any society. The Royal Society is also drawing up, with the co-operation of the principal societies and institutions, a list of scientific and technical men actually on active service in His Majesty's Forces. Any names, with rank and unit, for this list will be gratefully received by the secretaries at Burlington House. The task of forming this Register has been much facilitated by the assistance of many universities, university colleges and scientific societies, whose help the Royal Society gratefully acknowledges.

Electrical Volunteers.—An interesting scheme has been initiated by the Birmingham Volunteer Electrical Engineers, by which it is hoped to assist in the Territorial recruiting movement. This corps arranged to open premises at 56, Digbeth (joining their central depôt), as a recruiting office from Saturday, 21st inst., and with the assistance of Major Walduck and his staff, will recruit men for the Territorial and Volunteer Forces. A feature of the recruiting scheme is the acceptance of men between the ages of 17 and 19 who wish to join the Army. The Volunteer Force will give such men an elementary military training and a certain amount of technical work, so that when they join the Regular Forces they may be quickly fitted for service abroad. The recruiting authorities attach some importance to this venture, as they recognise that the early training of youths just below military age under Volunteer conditions gives them a liking for military work, and makes them of more use to the authorities, who, above all things, require men who can be quickly drafted to the various fighting units.—*Birmingham Daily Mail.*

Australia and Enemy Companies.—The High Commissioner for Australia has received information that a Proclamation was issued in the Commonwealth, dated July 7th, prohibiting trading with any company, the shares of which are wholly or mainly owned by persons of enemy nationality or resident or carrying on business in an enemy country, or which has been notified by the Attorney-General in the *Commonwealth Gazette*, as managed or controlled directly or indirectly by, or under the influence of, or carried on wholly or mainly for the benefit or on behalf of persons of enemy nationality or resident or carrying on business in an enemy country. It is intimated that exemptions from the provisions of the Proclamation may be granted by licence.—*Financial Times.*

Board of Trade Inquiries.—During the week ended August 14th, the Board of Trade Commercial Intelligence Branch received inquiries for manufacturers or producers in the United Kingdom of the following:—

Electrical apparatus.—Brass shells (without insulation) required for making electric lamp caps. Pea lamps, with cord and adapters complete.
Small brass-cased pressure gauges. Mica.

Suspending the Eight Hours Act.—On 18th inst., according to the Press, the Coal Mining Organisation Committee met at the Home Office, under the chairmanship of Sir Richard Redmayne, Chief Inspector of Mines, and decided to convene a conference of representatives of the Mining Association of Great Britain and the Miners' Federation to consider the desirability of suspending the Eight Hours Act in whole or in part.

Electricity Works' Employés and War Badges.—The Stirling Corporation electrical engineer has made application to the Ministry of Munitions for war badges for the employés of the electric station.

ELECTRIC RAILWAYS AND THE LAW OF NEGLIGENCE.

[FROM OUR LEGAL CONTRIBUTOR.]

For some reason, which admits of several explanations, accidents on electrical railways—in a good hour be it spoken—are few and far between. Accidents do, of course, occur, but they are relatively few because electric railways are not very numerous; and the elements of danger are considerably reduced by the extensive use of automatic signalling apparatus. The liability of the electric railway company, however, is precisely the same as that of any other company; and in view of the fact that persons injured are not slow to bring actions it may be convenient to set down a few notes upon the legal aspect of the matter.

Leaving out of the consideration for the moment employees of the railway company, and others who have business on the permanent way, the first question is to consider whether the company can be held liable for injuries sustained by a trespasser on the rails. In finding the solution to this question a sharp distinction has to be drawn between a tramway and an electric railway.

In the case of a tramway or light railway company who suspend naked conductors over streets and roads, there is a clear obligation to protect those of the public who are making lawful use of the road. If a wire were to fall and injure a passenger or other person by electric shock, the company would be held responsible. The position of a railway company is very different. They are using their own property, and they lay the live conductors in a position to which none save their own servants have any right of access. In these circumstances, if an accident takes place, is the company under any liability?

In order to decide the question, it is necessary to consider the liability of an ordinary railway company for injuries sustained by trespassers on their line. Take the case of a person crossing the line who is knocked down by a passing train. As he is a wrong-doer himself, and is guilty of culpable negligence, the law appears to be that he cannot make any claim. Strange to say, we have not been able to find any case which expressly decides the point, but the principle can be deduced from the following considerations:—

In the first place, it is provided by Sec. 23 of the regulation of Railways Act, 1868, that: "If any person shall be or pass upon any railway, except for the purpose of crossing the same at any authorised crossing, after having received warning by the company which works such railway, or by any of their agents or servants, not to go or pass thereon, every person so offending shall forfeit any sum not exceeding 40s. for every such offence." This section clearly makes a trespass upon a railway an illegal act, if the trespasser has received warning by notice or otherwise. It is conceived, however, that the absence of notice or warning would not be a sufficient justification for any person crossing the permanent way. In a case which was tried many years ago, an action was brought to recover damages for the death of a person who was found injured upon the line. There was no evidence to show how he got there. The company were held not liable (Singleton *v.* Eastern Counties Railway Co., 7 C.B.N.S., 287). Again, even assuming that the company can be held liable where one of their servants is injured, this liability cannot be artificially extended. So in the case of Woodley *v.* Metropolitan District Railway Co. (2. Ex. D. 384), a railway company was held not liable to the plaintiff, the servant of their contractor, for injury occasioned to him by their alleged negligence in the course of his employment on their line, the plaintiff knowing the danger of the employment.

There is one other aspect of the matter under discussion which merits attention. If stray cattle are injured on a railway, can the company be held liable? The answer to this question appears to depend on whether the company have discharged their statutory obligation to fence the line. Under 8 & 9 V. c. 20, s. 68, a railway company is bound to maintain sufficient fences for separating the land taken for the use of the railway from adjoining lands not taken, and protecting the cattle of the owners and occupiers from straying thereout. Hence, if a railway runs close to a highway, the separating fence must be so maintained as to prevent cattle lawfully passing along the highway from straying on to the line.

It may be noted, however, that if cattle stray from a field on to the highway, and from thence on to a railway, and are injured, their owner cannot prefer a successful claim, as the statute only compels the company to fence against cattle lawfully on the highway (Manchester, etc., Railway Co., *v.* Wallis 14 C.B., 213).

Assuming, then, that an ordinary railway company is under no liability to a trespasser, it is difficult to see why any greater degree of liability should be imposed upon an electric railway. Near a level crossing, of course, or at any point where a public footpath runs across the metals, the company would not only have to place warning notices, but they would probably have to attach wooden guard rails to the live conductors in order to relieve themselves from any charge of negligence. Owing to the fact that electric railways have been only comparatively recently introduced in this country, we have not been able to find any English case which bears upon the point. Certain American decisions, however, may be usefully referred to. They seem to accord with the principles above enunciated, and they certainly follow the well-known rule of English law that he who has the least chance of avoiding an accident is *prima facie* the person liable therefor.

In a case which was decided in America a few years ago the defendants were the owners of a power station which was situated in grounds where there were certain naked conductors. Notices were posted on this ground to the effect that it was dangerous for persons to enter thereon, and there was no right-of-way across it. The plaintiff was the wife of a man who went to the power station one evening and met his death through coming in contact with a naked conductor. In an action brought by the widow to recover damages for the death of her husband, it was held that the company owed no duty to the deceased to guard the premises, and that the Judge was right in directing a verdict for the defendants.

In another case (Thomas *v.* Western Union Telegraph Co., 100 Mass. 156), it was held that if a live high-pressure wire sags down in a street and occasions injury to passers by, this is a *prima facie* evidence of negligence; but the conduct of the person injured—such, for instance, as his voluntarily touching the wire—may have been such as to contribute to the injury. In that case he could not recover.

As carriers of passengers those who are responsible for electric railways are under the same liabilities as ordinary railway companies.

Panama-Pacific Exhibition.—A Reuter dispatch from San Francisco states that attendance at the Panama-Pacific Exposition has passed the 10,000,000 mark, according to an announcement by the Exposition directors. The daily average attendance is 70,000, and up to this time the receipts have been more than sufficient to pay all expenses. This is the first American exposition to pay its way and show a surplus since the Columbus Exposition in Chicago in 1893. The diversion of tourist traffic, owing to the war, is partly the cause of the success.

IMPORT TRADE OF CHILE.

The following statement, showing the imports of electrical and similar goods into Chile during the year 1913 is extracted from the recently-issued trade statistics. The figures for 1912 are added for purposes of comparison, and notes of any increases or decreases are given:—

	Pesos. 1912.	Pesos. 1913.	Pesos. Inc. or dec.
Gas and electricity meters.—			
From Great Britain ...	10,000	10,000	—
,, Germany	34,000	37,000	+ 3,000
,, United States ...	3,000	2,000	− 1,000
,, Other countries ...	4,000	3,000	− 1,000
Total	51,000	52,000	+ 1,000
Copper wire.—			
From Great Britain ...	30,000	201,000	+ 171,000
,, Germany	159,000	26,000	− 133,000
,, United States ...	17,000	21,000	+ 4,000
,, Other countries ...	24,000	24,000	—
Total	230,000	272,000	+ 42,000
Lamps (other than copper or brass).—			
From Great Britain ...	14,000	16,000	+ 2,000
,, Germany	95,000	74,000	− 21,000
,, United States ...	8,000	11,000	+ 3,000
,, Other countries ...	4,000	5,000	+ 1,000
Total	121,000	106,000	− 15,000
Telephones.—			
From Great Britain ...	18,000	15,000	− 3,000
,, Germany	130,000	121,000	− 9,000
,, United States ...	6,000	2,000	− 4,000
,, Other countries ...	3,000	3,000	—
Total	157,000	141,000	− 16,000
Telegraph apparatus.—			
From Great Britain ...	3,000	3,000	—
,, Germany	—	1,000	+ 1,000
,, Other countries ...	—	1,000	+ 1,000
Total	3,000	5,000	+ 2,000
Materials for telegraphs and telephones.—			
From Great Britain ...	96,000	102,000	+ 6,000
,, Germany	34,000	42,000	+ 8,000
,, Belgium	—	5,000	+ 5,000
,, United States ...	3,000	6,000	+ 3,000
,, Other countries ...	1,000	2,000	+ 1,000
Total	134,000	157,000	+ 23,000
Cranes.—			
From Great Britain ...	139,000	662,000	+ 523,000
,, Germany	91,000	47,000	− 44,000
,, United States ...	30,000	30,000	—
,, Other countries ...	26,000	32,000	+ 6,000
Total	386,000	771,000	+ 385,000
Machinery and apparatus for electric lighting.—			
From Great Britain ...	211,000	312,000	+ 101,000
,, Germany	1,031,000	1,351,000	+ 320,000
,, France	4,000	17,000	+ 13,000
,, Belgium	7,000	13,000	+ 6,000
,, United States ...	76,000	110,000	+ 34,000
,, Other countries ...	4,000	4,000	—
Total	1,333,000	1,807,000	+ 474,000
Electrical machinery and apparatus.—			
From Great Britain ...	132,000	147,000	+ 15,000
,, Germany	716,000	904,000	+ 188,000
,, France	4,000	7,000	+ 3,000
,, Belgium	47,000	17,000	− 30,000
,, United States ...	239,000	123,000	− 116,000
Total	1,138,000	1,198,000	+ 60,000
Motors.—			
From Great Britain ...	2,801,000	1,353,000	− 1,448,000
,, Germany	836,000	732,000	− 104,000
,, Belgium	150,000	148,000	− 2,000
,, United States ...	224,000	395,000	+ 171,000
,, Other countries ...	21,000	70,000	+ 49,000
Total	4,032,000	2,698,000	− 1,334,000
Insulators.—			
From Great Britain ...	10,000	23,000	+ 13,000
,, Germany	162,000	207,000	+ 45,000
,, United States ...	15,000	15,000	—
,, Other countries ...	3,000	21,000	+ 18,000
Total	190,000	266,000	+ 76,000

[N.B.—Peso = 1s. 6d.]

THE ARBITRATION CLAUSE.

[BY OUR LEGAL CONTRIBUTOR.]

THERE are probably few contractors who have never had occasion to regret the practice which has grown up of inserting the arbitration clause in construction contracts. In many cases where there is no dispute the question of arbitration is of no importance; but when trouble arises, the contractor may find that in order to obtain redress he must submit to the decision of some one with whose capacity for arriving at a just decision he may be wholly unacquainted.

Under the stress of competition, a man signs a contract containing an arbitration clause. It is only when it is too late that he finds out his mistake. "But," one can hear the layman asking, "is there no release from the arbitration clause?" The lawyer's answer is that there are certain rare cases in which the Courts will allow a party to a contract to have recourse to the ordinary tribunals of the land, notwithstanding that he has entered into a contract containing a clause under which all disputes are to be referred. In the first place, the matter is regulated by Sec. 4 of the Arbitration Act, 1889. It is there provided that—

> If any party to a submission, or any person claiming through or under him, commences any legal proceedings in any Court against any other party to the submission, or any person claiming through or under him in respect to any matter agreed to be referred, any party to such legal proceedings may at any time after appearance and before delivering any pleadings or taking any other steps in the proceedings apply to that Court to stay the proceedings, and that Court or a judge thereof if satisfied that there is no reason why the matter should not be referred in accordance with the submission, and that the applicant was at the time when the proceedings were commenced and still remains ready and willing to do all things necessary to the proper conduct of the arbitration, may make an order staying the proceedings.

This clause is generally used to obtain the stay of proceedings in an action where one party desires to insist upon his rights under the arbitration clause. For instance, suppose a contractor made a claim for extras, and the employers' contention was either that nothing was due for extras or that they had already been paid for in the final certificate, this would be a dispute under the contract which the Courts would refuse to consider. Accordingly, were the contractor to bring an action, it could and would be stayed by order of the Court. The Court, however, has a discretion. Thus if the conduct of the engineer—designated as arbitrator in the contract—were in dispute, reference to arbitration would be obviously undesirable, and would not be enforced.

To enumerate the cases in which the Court will refuse to stay an action *in the exercise of its discretion* is not our present purpose. What we desire to point out is that there are certain classes of dispute which may arise between contractor and employer which do not come within the arbitration clause at all, and which cannot therefore be referred to arbitration.

A favourable example is afforded by a recent case, Monro *v.* Bognor Urban District Council. (Reported in the *Justice of the Peace*, July 10th, 1915.) That was a case of a sewerage contract. Disputes arose during the progress of the contract as to the nature of the ground in which the works were to be carried out, which the contractor alleged was different from what he had by the specification been led to expect, and accordingly he brought an action against the Council, claiming, *inter alia*, damages for fraudulent misrepresentation. The Council thereupon sought to stay the action because of the arbitration clause. It was held that as the action was for fraudulent misrepresentation, there could not be said to be a question, dispute, or difference upon, or in relation to, or in connection with, the contract, and as such referable to arbitration within the meaning of the clause. The action had reference to matters wholly outside the powers of an arbitrator, and there was no power to stay proceedings.

This, of course, was a somewhat unusual case. Charges of fraud cannot be lightly made, and they are generally difficult to sustain. But the case will suffice to show that where the dispute is outside the contract altogether, the plaintiff is not restricted to arbitration, but can seek redress in the ordinary tribunals of the land.

BUSINESS NOTES.

Sequestration.—ARCHIBALD BAILLIE GILLESPIE, electrical engineer, 499, George Street, Aberdeen.—Estate sequestrated by the Sheriff of Aberdeen, August 16th. A meeting to elect the Trustee and Commissioners is called for August 30th. A composition may be offered at the meeting.

Catalogues and Lists.—MESSRS. DUGDELL'S PATENTS, Failsworth, Manchester.—Large poster card illustrating a varied collection of patterns of their patent adjustable electric light fittings.

GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—New edition (between 60 and 70 pages) of their catalogue of electric light fittings and accessories. This is the fourteenth edition, and it brings together for the use of electrical engineers, contractors, architects, &c., illustrations, brief particulars, and prices of a large number of established types of accessories, as well as novel designs, the ground covered including cord grips, hooks, screw eyes, nozzles, ceiling plates, anti-vibrators, cord shorteners, galleries, shade carriers, tilters, ball fittings, counter-weight fittings, candle fittings, wire guards, switchplates, wood blocks, reflectors for shop-window and showcase lighting, shop window signs, lantern fittings for workshop and open space lighting, cast-iron ship fittings, various types of hand lamps, including motor-car inspection lamps. There is a section devoted to different types of glassware, also fancy silk and glass shades, some new types being shown. In the chain section a new pattern rectangular link chain, three patterns of Cash's ornamental patent chain, and several new types of "S" hooks appear.

MESSRS. OZONAIR, LTD., 96, Victoria Street, London, S.W.—16-page pamphlet containing very full matter relating to the Ozonair system of food preservation and the application of the apparatus to domestic and general, also to commercial and industrial service. A number of types are illustrated and priced, and a collection of testimonials is given.

BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Descriptive list, No. 2,142A (24 pages) containing very full illustrated information, together with dimensional diagrams and particulars, concerning their two and three-phase induction motors.

Bankruptcy Proceedings.—VERNON GEORGE COBB, electrical engineer, trading with William Longdon as Longdon and Cobb, at 101A, Derby Road, Nottingham.—An application was made at the County Court House, St. Peter's Gate, Nottingham, on August 19th, for the discharge from bankruptcy of the above-named debtor, Vernon George Cobb. It was stated that a first and final dividend of 1s. 4¾d. in the £ was paid, on proofs of the partnership, amounting to £243. The firm had practically been pressed by creditors ever since the commencement, and the books had never been balanced. The discharge was granted, subject to a suspension of two and a half years.

ARTHUR F. HAWDON, electrical engineer, Yetholm, Elmfield Gardens, Gosforth, Northumberland.—Receiving order made August 16th, on creditor's petition; first meeting, September 1st, at the office of the Official Receiver, Newcastle-on-Tyne. Public examination, October 7th, at the County Court, Newcastle-on-Tyne.

W. H. PEASE, electrical engineer, of Scarborough and Doncaster. Trustee (Mr. J. C. Clegg, 14, Figtree Lane, Sheffield, Official Receiver), released June 24th.

Dissolutions and Liquidations.—THE PHŒNIX ELECTRIC HEATING CO. (1914), LTD.—This company is winding up voluntarily with Mr. A. E. Tilley, of 8, Staple Inn, Holborn, E.C., as liquidator. A meeting of creditors is called for September 1st.

NORTH-WESTERN CABLES CO., Longford Road, Stretford.—Messrs. John Drennan, Jas. K. Cooper, and A. E. Garbutt, carrying on business under the above style, have dissolved partnership. Debts will be attended to by Messrs. Drennan & Cooper.

TURBINE DEVELOPMENT CO., LTD.—A meeting is called for September 22nd, at Finsbury House, Blomfield Street, London, E.C., to hear an account of the winding up from the liquidator, Mr. G. D. Price.

LESKOLE CO., LTD.—A meeting is called for September 27th, at 31, Great James Street, Bedford Row, W.C., to hear an account of the winding up from the liquidator, Mr. A. H. Crowe.

Book Notices.—"Electricity for the Farm." By F. J. Anderson. London: McMillan & Co. Price 5s. 6d. net.

"Specification and Design of Dynamo-Electric Machinery." By Miles Walker. London: Longmans & Co. Price 32s. net.

City and Guilds of London Institute. Department of Technology, South Kensington, S.W. Programme for the session 1915-16. London: John Murray. Price 9d. net.

"The Rare Earth Industry." By Sydney J. Johnstone. London: Crosby Lockwood & Son. Price 7s. 6d. net.

"*Bulletin* de la Société Internationale des Electriciens." Vol. V. No. 44. July, 1915. Paris: Gauthier-Villars. Prix 3 fr.

Proceedings of the Incorporated Municipal Electrical Association, 1915. London: Wyman & Sons, Ltd. 5s.

Trade Announcement.—THE AUTOMOBILE AND ELECTRICAL EQUIPMENT CO., of 2, Kingly Street, Regent Street, W., have transferred their office and showrooms to Grafton House, Golden Square, Regent Street, W., with works and garage situated in Bridle Lane, Golden Square, W. The telephone number remains: "Gerrard 1701." The change is consequent upon increased business.

E.C.C. Horticultural Show. — The second annual Exhibition in connection with the E.C.C. Works' Institute Horticultural Society was held on Saturday, and was open to all servants of the Electric Construction Co., Ltd., Bushbury, near Wolverhampton. The Exhibition was held in the messroom of the works, and in accordance with war times, it was confined, so far as regards prizes, to a vegetable display. In this the society was successful, for the exhibits were a credit to the employés. Mr. W. M. Furniss, president of the society, delivered a brief address. Mr. James Gray, the managing director of the company, took the opportunity of expressing the thanks of the directors for the way in which the employés of the E.C.C. had responded to the recent demands made upon them. Many of the workmen had been subjected to taunts and sneers for remaining at home, but by doing so they had been doing their bit for their country just the same as the heroes in the trenches. A programme of sports was decided on the recreation ground during the afternoon.

LIGHTING and POWER NOTES.

Australia.—For the year ended December 31st last, the returns of the Newcastle (N.S.W.) municipal electricity works show that 1,598,663 units were sold, the consumers numbering 880, and the H.P. of motors connected, 2,270. The plant capacity of the works was 962 K.V.A., an increase of 300 K.V.A. during the year, and a further 625 K.V.A. is being added; some 115 miles of mains were in use, and seven sub-stations, with a transformer capacity of 1,030 KW.

The Melbourne (Victoria) City Council has reduced the rent of consumers' meters from 1s to 6d. per month.

The Kyneton (Victoria) Shire Council has adopted plans for the installation of electric light, instead of gas, and a loan of £10,000 is to be obtained from the Commonwealth Bank.

At Balaklava (South Australia), a meeting of ratepayers has approved of the installation of electric light, and the Council has been instructed to carry out the work.

The Coolangatta (Queensland) Municipal Council has obtained an Order in Council to supply electricity under the Electric Light and Powers Act of Queensland.—*Tenders.*

Perth (W.A.).—The report of the Council's electrical engineer for the six months ended April 30th, shows that the units sold were 1,790,658, an increase of 3½ per cent. over the corresponding period of last year; the total number of consumers connected was 6,769.—*Commonwealth Engineer.*

Bath.—Price Increase.—The T.C. has increased the price of current by 10 per cent. after the taking of the meter readings for the Michaelmas quarter.

Belfast. — Fire in Power Station. — On Saturday morning a rather serious fire took place in the power station; on the arrival of the fire brigade it was found that the roof over the boilers and coal bunkers was well alight. After an hour's hard work the fire was got under control. Fortunately the electrical machinery escaped injury, and the electrical supply was in no way affected.

Belturbet.—E.L. Contract.—At a meeting of the Council, called to consider the electric lighting contract for a period of three years, it was decided to postpone the question of a new contract, and to continue the present arrangement for a period of six months.

Bridlington.—Restricted Lighting.—The T.C. has received a letter from the military authorities to the effect that the lighting of Bridlington was still too bright, and threatening to cut off the electric and gas light at the mains before dusk if there was not forthwith a reduction effected. Further measures, therefore, are now being taken to reduce public and private lighting.

Canada.—The surveys of the Dominion Water Power Branch of the water powers of the Winnipeg River in the Province of Manitoba, and of the storage possibilities in the upper waters of this river in the Province of Ontario, show that it is economically feasible to develop, at eight power sites, over 409,700 continuous 24-hour W.H.P., all within 80 miles of the City of Winnipeg, and within feasible transmission distance of all the commercial centres of the present settled portions of the Province of Manitoba. Of these eight power sites, there are three now under development, representing a total power capacity of 199,024 H.P. One site is completely developed by the Winnipeg Electric Railway Co., producing 28,000 H.P. The municipal plant of the City of Winnipeg at Point du Bois Falls has at the present time an installation capable of producing about 47,000 H.P. This plant is capable of extension to a maximum of nearly 80,000 24-hour H.P. Development at the third power site, at Great Falls, with a maximum possibility of 99,500 24-hour H.P., is now under way though temporarily delayed. At the two completed power developments there is therefore about 75,000 H.P. produced at the present time, and which can be increased to 108,000 24-hour H.P. The six remaining sites on the Winnipeg River are under the absolute control of the Dominion Government, and can furnish a further amount of 24-hour power to the maximum extent of 210,700 H.P. In addition there are several important power sites on the Winnipeg and English rivers, within the Province of Ontario, within easy transmission distance of the City of Winnipeg. Considering all the water power sites on these two rivers in the Provinces of Manitoba and Ontario, there is within transmission radius of the City of Winnipeg, a grand total of 570,000 24-hour H.P.—*Canadian Electrical News.*

The Canadian Light and Power Co., a hydroelectric undertaking owned by the Montreal Tramways and Power Co., is making arrangements to supply power to the Tramways Co., and will ultimately be able to develop 75,000 H.P. at its plant at St. Timothee, 28 miles from Montreal. This power is supplied to the company's sub-station on the outskirts of Montreal over a duplicate three-wire steel-tower transmission line. The company has the perpetual right to distribute and sell energy in Montreal and several adjacent counties. In 1913 the entire distribution system in Montreal City was taken over by the Montreal Public Service Corporation.

Electric Cooking.—In Winnipeg the city authorities give a rate of 1 cent per KW.-hour, less 10 per cent. discount, with a minimum charge of 75 cents per KW. installed, for cooking and heating purposes, and it is believed that there are some 3,000 cooking apparatus installed, including complete range equipments in eight apartment blocks. Fort William has from four to five hundred ranges in use, with one apartment block completely equipped. Saskatoon has 200 ranges, with four apartment blocks equipped. Edmonton has 100 ranges, with one apartment block and one electric baker's oven for 60 loaves; while Calgary and Selkirk each have 50 ranges. There are, of course, numerous other completely equipped public institutions in Western Canada, and quite recently a large capacity baking oven was placed in service in a western University.

Cork.—Price Increase. — The Corporation Public Works Committee has been informed by the Cork Electric Tramway and Lighting Co. that it is proposed to increase the rates for electricity by 10 per cent., as from July 1st. The matter was referred to the city solicitor for report.

Croydon.—The B. of T. has issued an order enabling the County of London Electric Supply Co. to supply current in bulk to the South Metropolitan Electric Tramways and Lighting Co., Ltd., whose order affects the R.D.C.

Denby.—E.L. Proposal.—The U.D.C. has decided to invite a representative of the Yorkshire Electric Power Co. to meet it with reference to the application of the company to supply energy for lighting and other purposes in the district.

Erith.—Price Increase.—The U.D.C. has advanced the price of current from, and after, October 1st by ½d. per unit for lighting, and by 10 per cent. for power.

King's Lynn.—Year's Working.—During the last financial year 615,803 units were sold by the electricity undertaking, a decrease as compared with the 669,874 units of the previous year. The consumers increased to 1,007, and 766-H.P. of motors were supplied. The total income was £9,000, and the gross profit £4,227, the net balance being £1,350, after meeting capital charges, &c. A balance of £3,908 brought forward was transferred to capital account (extinction of debt account). The total generating plant capacity was 920 KW.; maximum load, 515 KW.; and load factor, 14·5 per cent., as against nearly 17 per cent. in the preceding year.

Lerwick.—E.L. Proposals.—The question of electric lighting for the burgh has again been revived. Full consideration will be given the matter at the next meeting of the Town Council.

Reigate.—Street Lighting.—The Highways and Works Committee has recommended that 15 lamps on the Redhill Gas Co.'s mains and eight lamps on the Reigate Gas Co.'s mains be converted from gas to electricity, the Electric Lighting Committee to carry out the extension on the usual terms before March 31st next. The Council, however, decided that the work should be deferred until the months of February and March next.

South Africa.—In the tenth annual report of the Rand Water Board, Mr. W. Ingram, the chief engineer, gives some interesting comparative data relating to the pumping plant in use by the Board. Thus the Zwartkopjes reciprocating steam sets (380 H.P.) cost £26·7 per pump H.P., as compared with £14·18 per pump H.P. for the turbo-driven centrifugal set (189 H.P.) at the Villiage Main Reef pumping station. The steam consumption is less in the former case, but allowing for size, saving in cost of buildings, plant, &c., Mr. Ingram considers that the latter type of plant will probably supersede the former for surface pumping. Another comparison can be made at Springs where electrical pumps are in use, and electrically-driven three-throw horizontal reciprocating pumps cost £14·23 per pump H.P. (95 H.P.), while an electrically-driven centrifugal pump of the same size cost £3·62 per pump H.P. The space required by the latter was 735 sq. ft., as against 1,890 sq. ft., but the combined efficiency is lower, 69 as against 76 per cent. A summary shows that prime movers (pumping plant) represented 3,938 pump H.P.; prime movers (generators, &c.), 3,490 electrical H.P.; and H.P. driven electrically from the Board's generating plant, 2,814. The total number of stops due to electrical disturbances for the year to March 31st last was 46, and the time involved totalled 148 hours; these figures compare with 34 stops and 64 hours in the previous year. Damage was done to electrical machinery on 20 occasions, repairs costing £84. The report contains a variety of information regarding water supply on the Rand.

Stretford.—The Trafford Power and Light Supply (1902), Ltd., has had plans passed by the D.C. for a sub-station in Elevator Road, and for H.T. mains in Trafford Park Road.

U.S.A.—Electrified Farming.—Already 125 farmers in Lancaster County, Pa., are taking electric service from the lines of the central station companies which cross the county, and of this number 30 have installed motors. So many inquiries have been received from farm owners in the section that one of the Lancaster electric companies is considering the installation of a special department to look after farm business.—*Elec. World.*

TRAMWAY and RAILWAY NOTES.

Belfast.—The Corporation has rejected the recommendations of the Tramway and Electricity Committee to increase the fares, except on the Glengormley route, and an amendment was carried instructing the Committee to investigate the working expenses, and revise these so as to meet whatever portion of the deficit will not be met by the proposed alteration of fares.

The city accountant's estimate of revenue for the coming year of the tramway undertaking was :—Revenue, £270,000 ; expenditure, £275,400 ; deficit, £5,400. Mr. Nance (the general manager) estimated the revenue at £283,000.

Bingley.—The Electricity and Tramways Committee has appointed a deputation to interview the Bradford Corporation tramways department with reference to the price of current supplied for tramway purposes.

Blackpool.—The receipts on the Blackpool and Fleetwood electric cars, up to date for the current year, amount to £22,450 against £25,974 12 months ago. Curiously, the weekly returns show the receipts to be £2,342 against £1,711 last year.

Continental Notes.—Spain.—Electric lighting has just been adopted on the trains running on the lines of the Compania del Ferrocarril Cantanabrico.

Belgium.—According to the *Engineer*, in Belgium the Germans are running storage battery cars on the short lengths of railway which lead up to the trenches behind their lines. They are being run singly to remove the wounded and bring up supplies.

Glasgow.—Tramway Breakdown. — Owing to the breakdown of one of the turbines in the Pinkston power station on Wednesday, last week, a complete stoppage of the car traffic all over the T.C. system was brought about. The spare machinery at the station was at once brought into requisition, but only progress in sections was secured, until after the lapse of about a couple of hours when the service returned to normal.

Huddersfield.—Proposed Extensions.—The Tramway Committee has decided to postpone until next year the promotion of the Parliamentary Bill providing for extensions to Brighouse, subject to this course being agreeable to the Brighouse Corporation. In regard to a proposed extension to Meltham, that Council is to endeavour to arrange terms with the South Crosland Council. The tramway employés recently raised a number of points in regard to increased wages, the employment of women conductors, &c, but eventually withdrew all their points and simply asked for a war bonus. The Tramways Committee has decided to pay a war bonus of 1s. per week to tramway employés receiving over 30s. per week wages, to take effect as from March 17th last, but not to apply to the clerical staff and females.

L. & S.W. Railway Electrification.—It is now announced that the first section of this company's line to be opened for electric working will be that between Waterloo and Wimbledon, via East Putney.

Portsmouth.—Year's Working.—For the year ended March 31st last, the total revenue of the tramways undertaking was £123,991 (12·2d. per c.m.) as against £116,990 in the previous year ; the net balance after meeting interest and sinking fund charges, &c., was £24,075, as compared with £19,042 in 1913-4. The balance, together with £10,703 brought forward, was appropriated for various purposes, including £10,000 for rate aid (as against £5,000 in 1913-4), £7,186 to renewals and £3,000 to reserve ; £3,302 was devoted to purchasing property and £3,000 reserved for a road improvement, and, finally, a balance of £6,568 was carried forward. The number of passengers carried was 27,554,194, an increase of 1,287,852. Apparently the war only had a temporarily depressing effect on the undertaking during the year under review.

Salford.—Female Labour.—The number of women tramway conductors employed has been increased from 16 to 55, and according to a statement the experiment of employing women on the cars has succeeded beyond expectations.

Wigan.—War Wages.—The Committee on Production, which has been dealing with the application of the tramway workers for an advance of wages, issued its award on the 18th inst. The men originally asked for an advance of ½d. per hour on the existing rate of pay for motormen, conductors and depôt employés, and for an advance of 1d. per hour for the electricians in the tram depôts. In April last the Corporation decided to pay a war bonus to employés, and approximately 95 per cent. of the men benefited. Later the men made their further demand, and struck work on August 2nd. The Committee on Production states that, having regard to the present scale of pay, and the war bonus which has been granted, the wages of conductors should be advanced in accordance with the offer of the Corporation, ½d. per hour, as from the first full pay week following the date of this decision, the wages of the other grades to remain unaltered.

Wolverhampton.—Female Labour.—As 75, out of a staff of 220 of the Corporation tramways, have enlisted, and owing to the difficulty of obtaining men, the Tramways Committee is considering the question of employing women as conductors, and in other capacities.

TELEGRAPH and TELEPHONE NOTES.

Canada.—The financial statement of the Dominion Telegraph Co. for the year ended June 15th shows a balance to the credit of profit and loss account of $291,961.88.

Mexico.—Large forces of linemen are at work on the telegraph lines in Mexico to restore communication to Mexico City. Thousands of messages have accumulated. The first cable message reached Mexico City on July 12th, and the first through train from Vera Cruz arrived at the capital the same day.—*T. and T. Age.*

New Cable.—The Telegraph Construction and Maintenance Co.'s cable steamer *Colonia*, on July 23rd, successfully completed the laying of a second cable between New York and Colon, *viâ* Guantanamo, Cuba, for the Mexican Telegraph Co. and the Central and South American Telegraph Co. This duplicates the cable laid by the same company in 1907 and completes the duplication of the whole "*viâ* Colon" system from New York to Buenos Ayres, Argentina.

The first adjustment of the duplex balance on this new cable indicates that when the balance is perfectly adjusted a speed of fully 200 letters per minute will be obtained.—*Telegraph and Telephone Age.*

New York Telephone Directory.—The new edition of the New York telephone directory consists of 1,750,000 copies. It contains 345,000 names and has a circulation of 865,000 copies in New York City and vicinity. There are 193,000 names in the general suburban directory, which has a circulation of 617,000. The combined distribution in metropolitan territory will reach 1,750,500.—*Telegraph and Telephone Age.*

Secret Wireless.—It is reported from Rome that the police have arrested several persons who had a wireless telegraph installation concealed in the suburbs of the capital. The accused, who belong to the Engineering Corps, will be tried by court-martial.

Suit Against American Marconi Co.—Mr. Nikola Tesla has brought a suit against the Marconi Wireless Telegraph Co. of America for the annulment of the principal Marconi patents, also a suit for infringement of his patents. Mr. Tesla bases his action on the allegation that his two patents were granted in 1900, and that the Marconi patent was not granted until 1904. The Marconi Co. denies that the Marconi patent covers the invention or combination of apparatus described by the Tesla patents.—*T. and T. Age.*

United States.—It is reported from Washington, U.S.A., that a certain rich German-American, who is the possessor of a powerful wireless apparatus, has picked up messages which were intended for the Navy station at Arlington, and transmitted them immediately to Count von Bernstorff.

Wireless News.—The *Wireless Press* announces that it has made arrangements for the regular reception of the Italian Official Communiqués by wireless telegraphy direct from Italy, in the original language. These will be translated, censored and passed to the Press in the regular way. The advantages derived from reception in Italian are obvious.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—September 1st. Condensers, testing sets, rheostats, Morse sounders, and Wheatstone transmitters, for the P.M.G. See "Official Notices" July 23rd.

October 6th. Portable direct-coupled internal combustion engine and dynamo ; extension to storage batteries at Central Exchange, for Deputy P.M.G.*

Brisbane.—October 6th. Tinned-copper wire, porcelain pothead insulators, for the P.M.G. See "Official Notices" August 20th.

Perth.—September 29th. Telephone switchboard parts, for the P.M.G. See "Official Notices" July 30th.

Sydney.—September 13th. Council. A.C. and D.C. electric motors. Specification (10s. 6d.) from E.L. Department, Town Hall.*

September 6th. Metropolitan Board of Water Supply and Sewerage. Centrifugal pumps and electric motors at Richmond pumping station.* Acting Secretary, 341, Pitt Street, Sydney.

September 23rd. Condensers, galvanometers, relays, and sounders, also incandescent electric lamps, for the P.M.G.'s Dept. See "Official Notices" August 13th.

October 25th. Six electrically-operated wharf capstans, for the Sydney Harbour Trust. Forms of tender from the Engineer-in-Chief, Harbour Trust Offices, Circular Quay.*

October 25th. For the Commonwealth Department of Defence (Navy Office). Supply, delivery and erection of power-station plant and equipment for the Commonwealth Naval Dockyard, Sydney.*

MELBOURNE.—September 8th. Transformers and relays for point indication for automatic signalling (Contract No. 28,918), and electric point and lock detectors (Contract No. 28,951), for a period of five years, for the Victorian Railway Commissioners.

September 29th. Fuse blocks (complete and spare porcelain bases and fuse clips), for the Victorian Railway Commissioners. Particulars at the Contractors' Room, Spencer Street.

September 7th. Supply and delivery of telephone parts (Schedule No. 1,243), for the Deputy P.M.G.

September 14th. Supply and delivery of telephone switchboard parts (Schedule No. 1,220), for the Deputy P.M.G. Specifications from the office of the Deputy Postmaster-General, Melbourne.*

HAWTHORN.—November 30th. Refuse destructor plant, for the Hawthorn-Malvern-Camberwell and Kew Destructor Trust. Specification from the Trust Engineer's Office, Town Hall.

France.—PARIS.—September 10th. The Administration de Chemins de Fer de l'Etat invites tenders for the supply of three-phase static transformers for the railway station, workshops and depôt at Mans. Particulars of the Bureaux du Service Electrique (2e Division), 43, Rue de Rome, Paris.

Kirkcaldy.—September 6th. Installation of electric light at the new Sanatorium and Fever Hospital buildings. Specifications, &c., from the Burgh Electrical Engineer.

New Zealand.—September 1st. Public Service Stores Tender Board. Supply and delivery of (1) 92 miles of air-spaced, paper-insulated, lead-covered telephone cable, and (2) 100 miles of insulated and braided wire. Controller of Stores, Post and Telegraph Department, Wellington.*

DUNEDIN.—November 3rd. City Council. Supply and delivery of insulated and bare copper wire in quantities for a period of two years. Specifications at Electrical Engineer's office, Market Street, Dunedin.—*New Zealand Shipping and Commerce.*

Portsmouth.—August 31st. Corporation. Six months' supply of stores, for the Tramway Committee. See "Official Notices" August 20th.

Shanghai.—September 24th. Municipal Council. One turbo-generator, 5,000 KW., and one or two of 10,000 KW., complete with condensing plant, &c. See "Official Notices" August 20th.

September 29th. E.H.T. switchgear, static transformers, and underground cables for 22,000 v., for the Municipal Council. See "Official Notices" to-day.

South Africa.—JOHANNESBURG.—September 25th. For the T.C. Two turbo-alternator sets, condensing plant, switchgear, &c. Specification, &c., on deposit of £2 2s., from Mr. J. H. Dobson, General Manager.*

September 25th. Municipal Council. 1,595 electricity meters and 50 time switches.*

October 9th. Municipal Council. Water-purifying plant with a capacity of 75,000 gallons per 24 hours, for the generating station.*

Spain.—September 1st. The municipal authorities of Balza (Province of Jaen) are asking for tenders for the concession for the electric lighting of the town during a period of five years.

Tenders have just been invited by the municipal authorities of Cullera (Province of Valencia) for the concession for the electric lighting of the town.

The Spanish Government has just invited tenders for the establishment of electricity-generating plant in the State Arsenals at Carthagena and La Carraca. It has been decided that offers from Spanish concerns will be considered.

Taunton.—August 31st. Coal for the Corporation electricity works for three, six, or twelve months (approximately 900, 1,500, and 2,700 tons respectively), preferably washed beans or peas suitable for use on a chain-grate stoker. Mr. A. J. Howard, Electrical Engineer, St. James's Street.

West Ham.—September 2nd. Three months' supply of electrical fittings, for the B. of G. of the West Ham Union. Forms of tender from the Clerk, Union Road, Leytonstone, N.E.

York.—September 6th. Supply of coal (approx. 15,000 tons) to the Electricity Department for 12 months ending September 30th, 1916. Prices may be sent for unscreened beans, pea slack, rough slack, or small peas quality, and must include free delivery. Mr. J. W. Hame, Engineer and Manager, Clifford Street.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been placed :—

VICTORIAN RAILWAYS.

Overhead equipment for St. Kilda-Brighton electric street railway, at rates.—B.I. & Helsby Cables.
Steel tramway rails, at rates.—R. W. Cameron & Co.
Lead-covered, impregnated, paper-insulated, twin wire cable, at £62 per mile of 1,760 lineal yards, at rates.—Western Electric Co. (Aust.), Ltd.
Switchgear and accessories, at rates.—Siemens Bros. Dynamo Works, Ltd.
Motors and spare parts for same, for electrical equipment of the Ballarat and Bendigo workshops.—Crompton & Co., Ltd.
Static transformers, 50 KW., complete, for Arden St eet and Spencer Street shops, at £68 10s. each; incandescent electric lamps for 12 months.—Aust. General Electric Co.
Sulphate of copper.—S. R. O. Allen.
25 tons of H.D. copper wire, at £38 15s. 10d. per ton.—Elder, Smith and Co., Ltd.

MUNICIPAL COUNCIL OF SYDNEY.

Two 5,000-volt feeder panels, two 5,000-volt transformer panels, two 415-volt transformer panels, and two 415-volt distributor panels, £844.—Aust. General Electric Co.
Two 10,000-volt feeder panels, and two 70,000-volt transformer panels, £652.—Noyes Bros.
Steel towers for 33,000-volt transmission line, £9,300.—Poole & Steel.

P.M.G.'s DEPARTMENT, VICTORIA.

Two miles of paper-insulated, lead-covered cable, 13 pairs, £68 per mile; two miles ditto, 26 pairs, £110 per mile.—Lawrence & Hanson Electrical Co.

P.M.G.'s DEPARTMENT, SOUTH AUSTRALIA.

Power board and apparatus, £478.—Newton, McLaren, Ltd.
1,100 yards of paper-insulated conductor cable, 416 pairs, £1,237.—Western Electric Co. (Aust.), Ltd.

P.M.G.'s DEPARTMENT, TASMANIA.

1,259 yards of paper-insulated cable, 812 pairs, £1,080.—Siemens Bros. Dynamo Works, Ltd. —*Aust. Mining Standard.*

COMMONWEALTH DEFENCE DEPARTMENT.

Marconi-Telefunken type A 2 ship wireless telegraphy station, £585; Marconi 1½-KW. wireless telegraphy station, complete, £1,225.—Amalgamated Wireless (Aust.), Ltd.

MELBOURNE CITY COUNCIL.

Electrical stores for 12 months.—W. T. Henley's Telegraph Works Co., Ltd.; Diamond Engineering & Trading Co. Pty., Ltd.; Edison & Swan U.E.L. Co., Ltd.; A. L. Campbell & Co.; B.I. & Helsby Cables, Ltd.; Warburton, Franki, Ltd.; Lawrence & Hanson Electrical Co., Ltd.; British General Electric Co., Ltd.; Aust. General Electric Co.
Extension of pumping chamber at the supply station, £2,973.—W. Cerutty. —*Tenders.*

Blackpool.—The General Purposes Committee has accepted the tender of Messrs. Jones Bros. for the electric lighting at the Convalescent Home, Clifton Park Racecourse, Squire's Gate.

France.—The results of the Paris adjudication of July 28th were :—For supply and erection of electric transmission equipment at the St. Lazare station, Société Anonyme de Force et Lumière Electrique, 45,900 fr.; ditto at the Asnières sub-station, MM. Bergerot et Fils, 11,800 fr. August 4th.—Supply of 10-ton lorries, M. Otis Pifre, 4,300 fr.; supply of three travelling bridges, Gaillard-Kessler, Argenteuil, 75,010 fr.; supply and erection of bare copper bars joining the accumulators at the central station at Saintes to the switchboards of the battery groups, Compagnie Générale de Travaux d'Eclairage et de Force, 8,600 fr.

Glasgow.—The T.C. Electricity Committee has accepted the offer of the General Electric Co., Ltd., at £50, for the frontal sign in connection with the equipping and furnishing of the departmental showrooms at Sauchiehall Street. The following offers have been accepted by the Tramways Committee :—

Storage battery for Kinning Park sub-station.—Chloride Electrical Storage Co., Ltd.
Motor-generator and switchboard.—Mavor & Coulson, Ltd.
Vulcanised rubber cables.—Pirelli-General Cable Works, Ltd.

Holywell.—The B. of G. has accepted the tender of Messrs. Summerscales, Ltd., of Keighley, for electric plant for the laundry, at £300.

London.—The tender of Messrs. Siemens Bros. Dynamo Works, Ltd., for the supply of Wotan lamps to the Great Central Railway has been accepted.

Messrs. Napier-Kimber, Ltd., have secured the contract for electric lighting at H.M. Stationery Office, Loman Street, E., for H.M. Office of Works.

New Zealand.—The Public Service Stores Tender Board, Wellington, has received the following tenders for 120 miles twin-twisted rubber-insulated wire :—

P. R. Baillie & Co. .. .. (accepted)	£1,931
Lawrence & Hanson Electrical Co.	1,976
Richardson, McCabe & Co.	2,124
Gollen & Co. Prop., Ltd.	2,479
A. & T. Burt, Ltd.	2,547
Turnbull & Jones, Ltd.	2,610
Samuel Brown, Ltd.	3,928

The Wellington City Council has accepted the under-mentioned tenders :—

Switchpanels and instruments.—British General Electric Co.
Meters.—P. R. Baillie & Co.
—*New Zealand Shipping and Commerce.*

Stirling.—The following offers have been accepted in connection with the new municipal buildings :—

Electric lighting.—Lockhart & Macnab.
Telephones and bells.—W. & T. Marshall.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, September 4th. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "Ball and Roller Bearings," by Mr. A. H. Hindle.

REVIEWS.

The Electrical Conductivity and Ionisation Constants of Organic Compounds. By H. Scudden. London: Constable and Co. Price 12s. 6d. net.

This is a reference book of data for electro-chemists, and its aim is to supply them with a bibliography of all the measurements in the field designated by the title, between the years 1889 and 1910. Beginning with the latter date, full data of the entire periodical literature are published in the "Tables Annuelles Internationales de Constantes et Données Numériques," while previous to the former date, little work of value at the present time had been published.

The book, therefore, fills a gap, and so supplies a definite want. It may not at present appeal to a very large circle of workers, for, outside the limited number of purely scientific investigators, its chief use will be to the chemists who are working out in detail problems pertaining to the application of the results of electrochemical research to the furtherance of existing chemical industries, and the founding of new ones.

Hitherto this field has been scarcely more than nibbled at in this country, so that while the author's work was being done and the work was going through the press, the prospects of reward for his monumental industry and for the courageous enterprise of his publishers, must have appeared remote indeed. The more honour, therefore, to both parties for providing us with so practical and effective a refutation of the German taunt that we are unable to produce such work for ourselves and are compelled to call upon the aid of our foes.

If, as we may perhaps venture to hope, with only too little encouragement, one of the results of the present European cataclysm should be to arouse the British chemical industry from its deadly lethargy, these rewards may materialise sooner and to a far greater extent than either author or publisher would have been warranted in anticipating. Some idea of the magnitude of the author's task may be found from his statement in the preface that seventy-eight of the journals and about five thousand dissertations have been examined page by page, besides the less important ones examined only by index and table of contents.

The book is divided into a set of tables arranged according to the names of the compounds, containing all the data that may be given, with a bibliography of all the references to each compound; a formula index to the compounds; a bibliography arranged according to the names of authors; a subject index to certain subjects; and a journal list giving the names of all journals examined, with the number and date of the last volume examined.—G. W. de Tunzelmann.

Electrical Instruments in Theory and Practice. By Murdoch and Oschwald. London: Whittaker & Co. Price 10s. 6d. net.

This book concerns itself chiefly with the theory of electrical instruments. A list of chapter headings will indicate the scope of this volume, which is to be followed by a volume dealing with oscillographs and various other A.C. instruments. There are ten chapters. The first is an historical summary; the second is devoted to electromagnetic damping, and deals with the equation $d^2\theta/dt^2 + a \cdot d\theta/dt + b \cdot \theta = 0$ in the general and in the more important particular cases. Chapters III to VII deal with moving coil, electrostatic, hot wire and dynamometer instruments; Chapter VIII treats of supply meters; Chapter IX of magnetic testing instruments; and the final chapter gives a brief account of P.O. box and potentiometer methods of measurement.

After the first chapter the treatment is naturally mathematical, but, by taking typical results of practical instrument tests, instructive comparisons are made between theory and practice. In the section on damping, for instance, the theory is compared with the results of experiments on an ordinary Kelvin galvanometer and a Grassot fluxmeter. The section on moving-coil instruments contains a very complete account of the theory and practice of such important instruments as the Megger, Ducter and vibration galvanometer, together with useful notes on the sensitiveness and design of moving-coil ammeters and voltmeters. Considerable attention is given to iron-cored instruments, and particularly to the use of such for A.C. measurement as proposed by Dr. Sumpner.

Supply meters are dealt with very thoroughly in a chapter which occupies more than a quarter of the book. Some paragraphs are devoted to the discussion of meter brake-disks, a subject about which very little has been written. The authors have apparently made an important series of experiments on the action of eddy currents in brake-disks, and the results as given here should be useful to designers of motor meters.

Chapter IX provides in less than 40 pages a neat summary of all the standard magnetic tests. All the time-honoured instruments and methods are given together with the more recent work of Ewing, Drysdale, Campbell, Murdoch, Wild and Kapp.

In this book Messrs. Murdoch and Oschwald have collected together much valuable information for which we have hitherto had to rely on the scanty treatment in electrical textbooks or the scattered papers and journals of the various learned societies—a service for which advanced students, designers and engineers ought to be devoutly thankful.—P.H.S.K.

NOTES.

Educational.—Northampton Polytechnic Institute.—The last day for receipt of applications from candidates for the Aitchison Memorial Scholarship who desire to be examined at a Local Centre is September 1st, and for those who wish examination in London, September 15th. Application should be made to the Hon. Secretary of the Trustees, Mr. Henry F. Purser, 35, Charles Street, Hatton Garden, E.C.

South-Western Polytechnic, Manresa Road, Chelsea.—This Polytechnic will reopen on September 27th for day and evening classes. The Engineering Courses include lectures in Electrical and Mechanical Engineering, Physics, Chemistry and Mathematics, and practical instruction in the fully-equipped laboratories of the Institute. Students are prepared by recognised teachers of the University of London for the B.Sc. Degree in Engineering of the University, for the examinations for admission to the various Engineering societies and the examinations of the City and Guilds of London Institute. The evening courses include besides the Engineering Courses as above, also classes in Electrical Wiring, Building Construction, and other trade subjects. In the Electric Wiring Department an advanced course has been arranged for the preparation of candidates for the final wiremen's examination of the City and Guilds of London Institute. Arrangements have been made for placing students who have passed satisfactorily through the three years' day course in positions with large engineering firms, and hitherto such firms have offered more vacancies than the Institute has been able to fill with its students. The prospectus may be obtained on application to the Secretary, Electrical Engineering Courses.

Goldsmiths' College, New Cross, S.E. — Engineering and Building Department. New session commences September 20th.

Royal Technical College, Glasgow.—Day Classes begin on September 28th; Evening Classes begin September 23rd.

University College (Faculty of Engineering), London.—Session begins October 4th.

Particulars are given in our advertisement pages.

Canadian Water Powers.—The latest statistical statement respecting Canadian water powers shows that within the provinces of the Dominion, and excluding the North-West Territories, practically all of the Yukon and the northern and eastern portions of Quebec, it is estimated that 17,764,000 H.P. are available, this amount being inclusive in the case of Niagara Falls, Fort Frances and the St. Mary's River at Sault Ste. Marie, of only the development permitted by international treaties, and, further, does not contemplate the full possibilities of storage for the improvement of capacities. The developed powers, which are inclusive of all water powers, whether for electrical production, pulp grinders, for milling or for the great many other uses, aggregate 1,712,193 H.P. as developed by turbines. This amount is distributed over the provinces, as shown in the following table:—

Nova Scotia	21,412
New Brunswick	13,390
Prince Edward Island	500
Quebec	520,000
Ontario	789,466
Manitoba	56,730
Saskatchewan	45
Alberta	33,305
British Columbia	265,345
Yukon	12,000
Total H.P.	1,712,193

—*Canadian Electrical News.*

Electrical Trade in Russia.—Mr. Consul Stevens, in his annual report on the trade of the district of Batoum for 1914, refers to electrical machinery, appliances and accessories, as follows:—"The trade in electrical machinery has very largely, in fact, I may even say altogether, fallen into German hands, but certain activity exhibited by manufacturers at home should succeed in gaining a part of the trade for British-made goods." He says that no trade in the district was so severely hit by the war as that of manganese. Later, in referring to electric supply matters, he says that he does not suppose there are many countries in the world in which so many rivers exist, the waters of which are adaptable for furnishing the energy required for working hydro-electric installations, as in the Caucasus, and yet up to now only about a dozen or so power stations exist. "In the Northern Caucasus a power plant developing up to 1,000 H.P. exists at the railway station of Beli Ugol on the River Podkumok, between Kislovodsk and Essentuki. At Gagri, on the Black Sea coast, Prince Oldenburg's climatic station possesses an electrical power plant, the water for which is taken from the River Joekvar. At the monastery of New Athos the monks also have erected a small electric plant. The Soukhoum Electric Co. have built a power station on the River Besletk, about five miles distant from the town. At Batoum Mr. Fefelov owns a water-power plant, situated six miles from the town, for furnishing electricity to house consumers. Messrs. Ananov Brothers have a small water-driven electrical installation in the Government of Kutais for working their saw mills. V. G. Shah-Paronian possesses a small electrical power station for driving machin ·y at Akhalkalaki. Another electrical water-power installat o i. of comparatively speaking small capacity, is erected at Borjom on the estates of the Grand Duke. At Sanain a hydraulic station of 700 H.P. exists for generating electricity. It is situated at the railway station of the same name and belongs to the Caucasus

Metallurgical Co. At Gori a small electric power plant is owned by Prince I.H. Amilahvari. The town of Erivan boasts of two water-power stations for electrical purposes; and lastly, similar power stations exist at the copper mines of Katar in the district of Zangezur and on the property of the Caucasus Copper Co. at Dzansoul. The latter is a station of some importance, as it develops over 1,000 H.P. A concession was granted by the Russian Government in November, 1912, to a British firm, the main features of which were the erection of power houses to accommodate turbines and generators for furnishing electrical energy for lighting and commercial purposes to cities, towns and industrial centres of the Northern and trans-Caucasus. With this object in view the concessionaires obtained permission to harness the waters of the River Terek at Kazbek on the Georgian military road, and those of Lake Goktscha near the village of Elenoffka in the Government of Erivan. The apparent object of constructing two stations so wide apart is to prevent the stoppage of supply of current in case of shortage of water in the River Terek, which at certain seasons of the year does occasionally occur. Some progress was made with the scheme during the first half of the year 1914. I understand all preliminary works connected with the project have been completed and plans prepared; but the financial side of the question has still to be solved, and it would be unreasonable to expect that this can be achieved before the close of the war, during which all further progress in maturing the scheme has had to be suspended."

In his concluding remarks, the Consul says that few countries exist which offer so much scope for the development of certain branches of British trade as the Caucasus does, and this in spite of strong outside competition, provided of course efforts are made to fall in with methods of business, which, although they may seem novel and adverse to British manufacturers and firms, are nevertheless so deeply rooted here that they have become a long established custom impossible to abolish and are, therefore, readily accepted by tradesmen and industries outside the United Kingdom. "Adaptability to the requirements of the markets, frequent periodical visits from commercial travellers knowing Russian, small stocks of goods in the hands of reliable agents, catalogues in the Russian language, low initial cost, cheap sea freights by direct steamers without transhipment to and from Caucasian ports between London, Liverpool, Glasgow, and one or two other of the more important harbours of the United Kingdom, mutual assistance in the maintenance of good relations and a system of credit freely—but carefully—granted, are all important points which should not be overlooked in the endeavours of British firms and manufacturers on the conclusion of peace to capture enemies' trade. Given these conditions the prospects for British commerce and industry are decidedly good."

Fatalities.—On August 19th, the Westminster Coroner held an inquiry into the death of a district messenger employed as lift boy at the offices of the Crown Agents for the Colonies. Apparently the boy was standing with one foot on the landing and the other foot on the lift, when a passenger, who entered the lift, accidentally touched the lift handle with his arm, and the lift ascended a little way. The boy slipped, and, falling between the landing and lift floor, dropped into the well. A verdict of "Accidental death" was returned.

On August 19th, while a tramway-car with 20 passengers was ascending a steep gradient in Barkerend Road, Bradford, the controller fused (according to the *Morning Post*); several passengers made a rush to leave the car while it was in motion, and one woman who jumped off sustained fatal injuries, others complaining of shock.

On the same day a signaller of the London Welsh Battalion was knocked down and killed by an electric car in Llandudno, the wheels passing over his body.

While a number of workmen were engaged in repair work at Bardyke's Colliery, Cambuslang, one of them, John McDougall, Blantyre, came in contact with the electric cable, and was killed instantaneously.

A coroner's inquiry was held at Jarrow on August 16th, into the death of John Stanton, a South Shields labourer, who died from injuries received in a tram accident on the 12th inst. While a car from South Shields was proceeding up Church Bank into Jarrow the current failed, and the car, running backwards, collided with a second car which was travelling in the same direction, and apparently caused a panic among the passengers. The motorman of the car which got out of control, said when the current went off he shut off the controller, gave the hand brake a turn, and applied the electric brake. The latter had no effect, and owing to the manner in which the men crowded upon him, he had not freedom to work the hand brake, but by the time the car reached the bottom of the bank he had the brake tight. If he had been able to get full control of the hand brake he could have stopped the car at the first flat. In regard to the second car, a witness said the driver reversed the controlling gear to run the car back, but the gear-box caught fire. Mr. A. G. Shearer, electrical superintendent of the Newcastle-on-Tyne Electric Supply Co., which supplies the current, said the supply on the Church Bank feeder was interrupted by some internal cause. All was in order at the sub-station. A verdict was returned that deceased died from injuries accidentally caused by falling from a disabled tramcar upon which he was a passenger.

Volunteer Notes.—Engineering Institutions' Volunteer Training Corps.—*Headquarters*, Marconi House, Strand, London, W.C. *Drill centre* (by kind permission of Lieut.-Col. A. E. Le Rossignol), Headquarters of London Electrical Engineers, 46, Regency Street, London, S.W.

Company Orders.—By Lieut.-Col. C. B. Clay, V.D., Commandant, for week ending September 4th, 1915:—

Monday.—Drills, 6.30 to 7.30. Section 1, Technical instruction; Sections 2, 3 and 4, Squad drill, musketry or signalling.

Wednesday.—No drill.

Friday.—Drills, 6.30 to 7.30. Section 2, Technical instruction; Sections 1, 3 and 4, Squad drill, musketry or signalling.

Saturday.—2.30. Promotion class. Members wishing to join Signalling class are requested to give in their names to their Section Commanders.

Musketry.—Arrangements are being made for the various Sections to go through a course of instruction at the Miniature Ranges in Greycoat Place—final particulars will be published later in Supplementary Orders.

E. G. Fleming,
Company Commander and Acting Adjutant.

Through Mr. A. Campbell Swinton, who is a director of Messrs. Crompton & Co., Ltd., this firm has offered to the Corps a 24-in. projector barrel and stand, which has been accepted.

The Corps is still open for suitable recruits, either from members of the Engineering Institutions, or from others who desire to join an engineering unit and take advantage of the training available at the Headquarters of, and under the staff of, the London Electrical Engineers (T.F.), who have kindly given every facility to this Corps. Applications to Lieut.-Col. C. B. Clay, V.D., M.I.M.E., M.I.E.E., Marconi House, Strand, W.C.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, August 26th, 1915:—

Captain of the Week, Captain Eastwood; Orderly Officer, Mr. G. T. Campbell.

Week-end Parades.—Saturday.—The Battalion will parade as strong as possible at Baker Street Station at 2.30 p.m., and proceed by march route to Wembley Park, *viâ* Gladstone Park. Rucksacks will be carried. Members can use their own discretion as to what they carry in the rucksacks, but the total weight of these articles should not be less than 20 lb.

Sunday, 7 a.m., Réveillé; 10 a.m., Church Parade; 10.20 a.m., Parade under Company Commanders; 2.15 p.m., Battalion Parade.

Appointment.—Mr. Brough Gurney-Randall to be Camp Quartermaster, *vice* Mr. Oliver Onions, dated August 5th, 1915.

Lecture.—There will be a lecture on Field Sketching delivered by Duncan H. Montgomery, Esq., on Sunday next, the 29th inst., at 10.30 a.m., in the ante-room of the Officers' Mess. All Officers not on duty will attend.

Musketry.—There will be firing at both Acton and Bisley Ranges on Saturday next, the 28th inst. Men who have sent in their names will parade at the usual times.

A. G. Joiner, *Captain and Adjutant.*

Appointment Vacant.—Depôt hand for Dover Corporation tramways. See our advertisement pages for particulars.

Radium in the United States.—It is announced by the United States Bureau of Mines that Government experimenters have succeeded in producing 1 gramme of radium metal at a total cost of £7,220, the previous selling price having been £22,400 to £23,200 a gramme.—*Chem. Trade. Jnl.*

Inquiry.—Makers of insulated zinc-covered tubing are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. G. Leslie Dennis has resigned his position of switchboard attendant under the West Bromwich Corporation to take up a similar post in H.M. Dockyard generating station, Devonport.

At the Parish Church, Wray, Hornby, on August 14th, the marriage took place of Mr. John Wm. Butterfield, late of the Oldham municipal electricity staff, and now serving in the 5th King's Own Lancs. Regiment, and Miss A. J. Stephenson, third daughter of Mr. J. Stephenson, Above Beck, Wray.

Mr. W. W. Lackie, city electrical engineer of Glasgow, has been appointed President of the Institute of Shipbuilders and Engineers at Glasgow. The Session opens in October, when he will deliver the inaugural lecture.

Mr. R. H. Lee, engineer-in-charge at the borough of Islington electricity works, has resigned in order to take up a similar appointment with the North Metropolitan Electric Power Supply Co.

General.—The following announcements appear in the *London Gazette*:—Territorial Force, Royal Engineers.

Electric Light Company, Renfrewshire (Fortress) Engineers; the undermentioned to be Second Lieutenants. Dated July 30th, 1915:—
Ian Cleland Napier.
Robert Norman Adam.

Electric Lights Company, East Riding (Fortress) Engineers; the undermentioned to be Second Lieutenants. Dated August 10th, 1915:—
Stanley Scott Allderidge.
Vyvyan James West.

4th Electric Lights Company, Kent (Fortress) Engineers.
Private James Wheatley Kilby, from London Electrical Engineers, to be Second Lieutenant. Dated July 31st, 1915.
Lieutenant Arthur P. Isard, A.M.I.E.E., to be temporary Captain. Dated August 10th, 1915.

Mr. P. J. S. Tiddeman has been appointed by the War Office Electrical Engineer for the Western Command, Headquarters at Chester.

The staff and employés of the Lanarkshire Tramways Co. have presented a timepiece to Mr. Stuart Evans, on the occasion of his leaving after eleven years' service as chief assistant engineer. Mr. Glennie, the assistant manager, made the presentation. Mrs. Evans was the recipient of a silver tea and coffee service.

Mr. F. M. Feiker, who has been for the last three years chairman of the editorial board of the A. W. Shaw Co., of Chicago, has been appointed editor of the *Electrical World*, New York, in succession to Dr. A. S. McAllister, whose resignation took place as from August 1st.

Mr. Alfred Still, a passenger on the White Star liner *Arabic*, which was torpedoed last week, is stated to be on the teaching staff of Lafayette University, Indiana. After rendering special service for some months in the works of Messrs. W. T. Glover & Co., Ltd., Trafford Park, he was returning to his home at Lafayette. Mr. Still landed safely at Queenstown.

Roll of Honour.—Private John Cartledge, of the 1/10th Manchester Regiment, who is now officially reported killed in action at the Dardanelles, was employed in the Oldham Corporation tramways department. He is the seventh local tramway employé killed on active service.

Sapper John Fearnley, of the Royal Naval Division, R.E., formerly an electrician in the Manchester electricity department, has been killed in action in the Dardanelles. He was 31 years of age.

Drummer Charles Cawley, aged 34, an employé at the electricity works, Bolton, has been killed in action. He served through the South African war.

Corporal John Basnett, of the 8th Battalion, Rifle Brigade, of Salford, who is unofficially reported killed, was 23 years of age, and formerly employed at the British Westinghouse Works in Trafford Park.

William Longworth, of Farnworth, has been awarded a D.C.M. When the British submarine E 15 ran aground in the Dardanelles, Longworth was one of the men who volunteered from H.M.S. *Majestic* to go in the picket boat and blow the submarine up to prevent it falling into the hands of the enemy. During his career in the Navy Longworth learned the business of an electrician, and took up work at Lord Ellesmere's Brackley Pits on leaving. When the war started he rejoined as an electrician.

Sapper George Lewis, of the 14th Signal Co., 14th Light Division Royal Engineers, who was a switchboard attendant at the Chesterfield Corporation Electricity Works, has been killed in action. He enlisted on September 7th, and was drafted to Belgium a few months ago.

NEW COMPANIES REGISTERED.

Runbaken Magneto Co., Ltd. (141,311).—This company was registered on August 18th, with a capital of £3,000 in £1 shares, to take over the business of magneto manufacturers carried on by J. H. Runbaken and Co., and to carry on the same and the business of manufacturers of spare parts for magnetos, ignition apparatus, and all kinds of electrical apparatus, electrical engineers and manufacturers, etc. The subscribers (with one share each) are: S. H. Flynne, Camp House, Broughton, Manchester, electrical manufacturer; J. H. Runbaken, 50, Nelson Street, Chorlton-on-Medlock, Manchester, manager. Private company. The first directors are J. H. Runbaken (managing director), H. P. Flynne and S. H. Flynne (all permanent, with £182, £39 and £130 per annum as remuneration). Qualification, 100 shares. Solicitor: W. J. Sharratt, 89, Fountain Street, Manchester.

Lindsay and Williams, Ltd. (141,305).—This company was registered on August 18th, with a capital of £2,000 in £1 shares, to take over the business of an insulating material manufacturer carried on by H. R. Williams at Medlock Works, London Road, Manchester, as "Lindsay and Williams." The subscribers (with one share each) are: H. R. Williams, 241, Upper Brook Street, Chorlton-on-Medlock, Manchester, analytical chemist; A. Weaver, 2, Mount Street, Manchester, accountant. Private company. The number of directors is not to be more than six; the first are not named. Solicitor: W. H. W. Menzies, 9, Albert Square, Manchester. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

Andover and District Electricity Co., Ltd. (141,280).—This company was registered on August 16th, with a capital of £10,000 in £1 shares, to take over from Messrs. Crompton & Co., Ltd., the transfer of and all benefits and rights under the Andover Electric Lighting Order, 1915, to carry out and work the undertaking authorised by such Order, or to apply directly for and acquire any similar or extended or other Electric Lighting Order, and to carry on the business of producers and suppliers of electric light and electrical currents or force, etc. The subscribers (with one share each) are: C. E. Sexton, Cofield, Redhill, Surrey, engineer; J. N. A. Houblon, Artillery Mansions, S.W., engineer; A. E. Mohring, Hurstpierpoint, Hornchurch, engineer; E. H. Arnold, The Lawn, Addleston, engineer; H. W. Braine, 25, Hamfirth Road, Stratford, E., clerk; C. R. Lee, 15, Cheveley Terrace, Chelmsford, clerk; J. W. Davies, Tyson Villa, Tyson Road, Forest Hill, S.E., assistant secretary to a public company. Minimum cash subscription, seven shares. The number of directors is not to be less than three or more than six; the first are T. Webb, 45, Market Place, Andover; Dr. E. A. Farr, Heath House, Andover; and J. A. Houblon, Artillery Mansions, S.W. Qualification, £100 shares. Remuneration, £25 each per annum (£50 for the chairman). Directors' borrowing powers restricted to £5,000. Registered office: 26, Bridge Street, Andover.

Electro Alloys, Ltd. (141,329).—This company was registered on August 20th, with a capital of £10,000 in £1 shares, to take over the existing inventions, rights and processes of E. B. Crombie relating to the precipitation of zinc and other metals, minerals and mineral oils, to carry on the business of metal merchants, metallurgists, metal separators and purifiers, engineers, electricians, consultants, plate makers, contractors, etc. The subscribers (with one share each) are: H. C. Mossop, 62-3, Queen Street, E.C., solicitor; C. E. Warren, Weybridge Cottage, Cannon's Lane, Pinner, secretary. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Qualification, £100. Remuneration, £50 each per annum. Secretary (*pro tem.*): C. E. Warren. Registered office: 62 and 63, Queen Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ramsden Green, Ltd.—Particulars of £1,000 debentures, created August 4th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £500. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Electro Flex Steel Co., Ltd.—A memorandum of satisfaction to the extent of £37,500 on July 30th, 1915, of debs. dated from December 19th, 1913, to September 29th, 1914, securing £45,000, has been filed.—Particulars of £40,000 debentures, created July 30th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £15,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Banbury and District Electric Supply Co., Ltd.—Issue on March 2nd, 1915, of £900 debs., part of a series of which particulars have already been filed.

Brecknell, Munro and Rogers, Ltd.—Particulars of £2,500 debentures, created August 9th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Rawlings Bros., Ltd.—Charge on certain leasehold lands and messuages dated August 9th, 1915, to secure all moneys due or to become due from the company to London County and Westminster Bank, Ltd., South Kensington branch.

William Beardmore and Co., Ltd.—Bond and disposition in security dated Aug. 3rd, 1915, to secure £150,000 charged on certain lands in Kilpatrick, Dumbartonshire. Holder: Secretary of State for War.

Winscombe Electric Light and Power Co., Ltd.—Issue on July 17th, 1915, of £870 debs., part of a series of which particulars have already been filed.

Chloride Electrical Storage Co., Ltd. (35,389).—Capital, £135,250 in 62,000 pref. and 73,250 ord. shares of £1 each. Return dated May 26th, 1915. All shares taken up. £75,738 paid on 48,750 pref. and 26,988 ord.; £59,512 considered as paid on 13,250 pref. and 46,262 ord. Mortgages and charges: Nil.

Everett, Edgcumbe and Co., Ltd. (84,764).—Capital, £25,000 in 5,000 6 per cent. cum. pref., 19,997 ord., and 3 "A" shares of £1 each. Return dated July 29th, 1915. 3,300 pref., 19,043 ord., and 3 "A" shares taken up. £11,496 paid on 2,500 pref., 8,995 ord., and 1 "A."; £10,850 considered as paid on 800 pref., 10,048 ord., and 2 "A." Mortgages and charges: £1,600.

Merthyr Electric Traction and Lighting Co., Ltd. (57,908).—Registered June 23rd, 1898. Capital, £100,000 in 6,000 pref. and 14,000 ord. shares of £5 each. Return dated May 31st, 1915. 6,000 pref. and 8,000 ord. shares taken up. £70,000 paid. Mortgages and charges, £48,400. Registered office: Electrical Federation Offices, 1, Kingsway, W.C.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

An extraordinary general meeting was held on Thursday last week, at Winchester House, Old Broad Street, Mr. E. P. Norton presiding. The Chairman, in proposing resolutions authorising the directors to carry into effect agreements made between the company and the Vancouver, Fraser Valley and Southern Railway Co., and the Vancouver Power Co., Ltd., remarked that the agreements were necessary in order to comply with the Dominion law. The company had to get certain franchises in different districts, and they were not always able, conveniently to themselves and profitably to the company, to take them out in the name of the parent company. They had, therefore, to be taken out in the names of the subsidiary companies. The two companies in question were the vested owners of certain of the lines which were operated by the parent company, and the Dominion law required that if one company operated the line owned by another company, there must be an agreement setting out the terms under which it operated, and the agreement must be ratified by the shareholders of the respective companies. As they held the whole of the shares in the subsidiary companies, there was no question of finance involved.

The resolutions were agreed to.

Replying to a shareholder, the Chairman said that the board had brought every possible pressure to bear upon the municipalities to control the Jitney traffic which competed unfairly with their cars, and shareholders who had interests in British Columbia could help by using individual pressure in the matter. There was no doubt that they were not being fairly treated by the municipalities, but they were hoping that they would soon get proper recognition.

Victoria Falls and Transvaal Power Co, Ltd.

The annual general meeting was held on Friday last, at Salisbury House, London Wall, Mr. Arthur E. Hadley (managing director) in the chair. In proposing the adoption of the report (p. 216), the Chairman, after referring to the absence of the Marquis of Winchester (chairman of the company), who is on active service, and to the death of Mr. Fricker (a director), said that the auditors' certificate was again satisfactory. With regard to the sum of £41,654 to which they referred, that sum included £3,500 deposited with the Dresdner Bank on behalf of the debenture trustees and £7,700 deposited on behalf of contractors' retentions, and was at their risk; the balance represented moneys which were remitted to Berlin prior to the war for payment of debenture interest in Berlin and which had, doubtless, been so paid out, but owing to the war it had not been possible for them to receive the discharged coupons. Turning to the balance sheet, the share

capital and first mortgage debenture capital remained at the same figure, viz., £3,000,000, under each heading. The second mortgage debentures outstanding at the date of the balance sheet amounted to £1,543,920, and included the issue in February, 1914, of £650,000. £82,580 of the second mortgage debentures had been purchased and cancelled during the year 1914, the total amount redeemed by purchase to December 31st, 1914, being £106,080. The creditors amounted to £422,158. Of this amount, £224,025 owing to creditors in London included a sum of £117,458 due to sundry debenture holders for interest accrued during the half-year ended December 31st, 1914, but not payable until January 1st, 1915. With regard to the amount of £78,884 owing on contractors' retention and general accounts, £7,721 was placed to a special account at the bank, and the remainder was included in the amount of £707,414 standing at the company's bankers and on loan, as was also the amount of £51,360 owing on contractors' general accounts. The profit and loss account showed a credit balance of £266,447. Turning to the other side of the balance sheet, the items of leases of concessions and purchase of undertakings again showed a decrease on last year's figure, being £1,536,638, as compared with £1,561,302, the difference being accounted for by the usual charge for depreciation and by certain small items which had been written off or sold or transferred to other accounts. The next item was the expenditure on and in connection with power stations, buildings, equipment and land which had been increased during the year by £395,753, in connection with the extensions they had made to the Simmerpan station and the installation of the extensions at Brakpan together with the expenditure on consumers' sub-station equipments and transmission lines. Their investment in the Rand Mines Power Supply Co., Ltd., figured in the balance sheet at £3,492,494 after writing off reserve for depreciation. The amount at which this investment stood in the balance sheet at December 31st, 1914, showed an increase over the previous year's account of £130,366. The Victoria Falls Co. held 500,000 shares of £1 each in the Rand Mines Power Supply Co., Ltd., together with a first mortgage bond fully securing the loan. The debtors and debit balances amounted to £60,571, and were all good and had practically all since been received by the company. The cash at bankers and on loan amounted to £801,633. The preliminary expenses again showed a decrease upon last year's figure of £2,500, the difference having been written off, together with all the expenses incurred during the period under review in connection with the issue of £650,000 second mortgage debentures. Dealing with the profit and loss account, the year's operations resulted in an increased gross profit over the preceding year of £87,871. In 1913 they carried to the appropriation account the sum of £467,823, and in respect of the year 1914 they had been able to carry to the appropriation account the sum of £555,694. The interest charge on debentures had increased from £203,920 to £234,842. The directors had applied the sum of £150,083 towards depreciation and certain writings off, carrying forward to the credit of the profit and loss account the sum of £161,248, increasing that account to £266,447. Out of this sum the directors had paid a dividend at the rate of 6 per cent. per annum for the six months ended June 30th, 1913, and a further dividend at the same rate for the ten months ending April 30th, 1914. These dividends were paid on January 6th and June 21st, 1915, respectively, and accounted for £160,000, thus leaving a sum of £106,447 remaining to the credit of the account as against £105,199 at December 31st, 1913. He thought they might take this increase, which enabled them to distribute an additional £40,000, as very satisfactory, since it showed the continued and growing prosperity of the undertaking. The monthly profits obtained so far during this year had again shown satisfactory increases, and they hoped to pay off the arrears of preference dividend in two equal instalments with the next two dividend payments. The heavy capital expenditure necessitated by the recent large extensions to the plant of the company and the Rand Mines Power Supply Co. had now practically terminated, but from next year onwards provision would have to be made for the redemption of the first debentures by annual instalments of £150,000. The sums arising from the provision made for depreciation had hitherto been required for extensions to the plants of both companies, but in future these annual provisions would be available for redemption of debentures. The times they were passing through made it a matter of extreme difficulty to forecast the future, but he might say that if the gold mining industry and their undertaking continued to work as at present, and every effort was being made in that direction, the board did not anticipate any difficulty in meeting those charges. Since the last meeting the extensions to the air compressing plant at Rosherville had been completed, and since the issue of the report information had been received that the whole of the extensions of 33,500 H.P. of electrical plant at the Brakpan station was now in commission. With the plant installed, they would be able to meet any normal increase in the business, which still continued to develop steadily, without encroaching on the specified reserve plant.

Replying to questions, the CHAIRMAN said that great strides had been made by the company, both last and this year, which, he thought, were leading on to the time within a year or two when the ordinary shares would receive a dividend. The published reports this year showed increases of between 20 and 25 per cent. over the same period last year.

The report was adopted.

Stewarts & Lloyds, Ltd.—Interim dividends for the half-year ended June 30th, at the rate of 6 per cent. per annum on the preference shares and 10 per cent. per annum on the preferred ordinary shares.

Crossley Bros., Ltd.—Interim dividend at the rate of 5 per cent. per annum on the cumulative preference shares and a dividend at the rate of 4 per cent. per annum on the ordinary shares.

Aberdeen Suburban Tramways Co., Ltd.—The profit earned during the past half-year amounted to £1,364, and there is a balance of £3,810 at the credit of the profit and loss account. It is proposed to add £1,500 to the amount at the credit of the renewal and depreciation account, which will then stand at £15,500; to pay a dividend at the rate of 5 per cent. for the past year; and to carry forward £716. Negotiations with the Corporation of Aberdeen for the purchase of the company's undertaking are still pending.

Manaos Tramways and Light Co., Ltd.—The report for the year ended April 30th, states, according to the *Financial Times*, that the gross receipts amounted to £110,420, a decrease of £22,457; the expenses were £84,240, a decrease of £12,608; and the net earnings £26,180, a decrease of £9,848. The fall in exchange has resulted in a loss of £6,180 on remittances during the year. After providing for interest, London charges, &c., placing £1,725 to debenture sinking fund and £300 to depreciation on furniture, there remains a profit balance of £4,002 to be carried forward. The State, Federal and Municipal Governments are still in arrears with their accounts, although as a result of strenuous efforts some collections have been made during the year, and it is hoped that further collections will be made in the near future.

Montreal Tramways Co.—For the year ended June 30th the gross earnings decreased $617,572, the operating expenses $492,118, and the net earnings $125,454. The ratio of operating expenses to earnings was 56·92 per cent., compared with 58·89 per cent. last year. The sum of $212,732 has been charged to contingent renewal account representing expenditures made for special renewals. In addition, $666,430 has been expended for the maintenance of plant and equipment, and charged to operating expenses, making the total expenditure during the year on upkeep $879,162. The gross earnings were $6,525,232; operating expenses, $3,713,996; net earnings, $2,811,235. There has to be deducted:—City percentage, $414,149; interest on bonds and loans, $825,415; interest on debenture stock, $800,000; taxes, $92,800; dividend (10 per cent), $278,880; contingent account, $275,000. Balance, surplus, $124,991.

STOCKS AND SHARES.

TUESDAY EVENING.

The excellent naval news of the beginning of the week had a marked effect upon the sentiment of the Stock Exchange. Prices were not greatly affected. Those who expected that advances would occur probably do not quite realise the conditions existing in the money markets at the present time. Without the aid of speculation to fan them, markets are bound to remain quiescent, dependent for their support upon what money remains over from the national subscription to the War Loan. Moreover, a large amount of capital is being held in reserve. All our economists and financial guides have told us that the country may need another loan soon after the end of the current financial year; and there is no doubt that reserves are being husbanded as much as possible, in order to conserve strength for the next requirements upon the national purse.

Germany is stated to be on the point of issuing a forced loan; and, from the details which have filtered through to this country, it is evident that drastic steps are to be taken with a view to replenishing the war chest—steps so drastic, indeed, that they may be fairly held to lead directly to the paths of peace, inasmuch as the adoption of a forced loan is about the lowest rung which can be reached by a nation before it drops off into bankruptcy.

The Electricity markets are steady enough, with the exception of Home Railway stocks, where prices continue dull. Central London ordinary is on offer in the neighbourhood of 72. Metropolitans and Districts are unchanged, but Underground Electric Incomes, after being up to 75¼, reacted to 74. The North-Western preference stock, issued a fortnight ago in order to complete the electrification of part of the system, has gone back a little to ¼ premium.

The question of exchange with the United States of America becomes daily of more pressing consequence, and all kinds of panaceas have been put forward in order to alleviate the situation caused by the enormous excess of American exports to this country over the imports received there from us. It is expected that a British loan of substantial amount will be placed in New York, with a view to correcting the exchange discrepancy. Without being accused of jobbing backwards, we may be permitted to repeat the opinion that, had a goodly slice of the June War Loan been offered to the United States, with the provision that interest would be paid free of income tax, the necessity would not have arisen for paying higher rates now.

New York Telephone bonds have risen to 99, so that this security is actually higher than the British War Loan, bearing the same rate of interest. The American gamble in "war specials," however, has received a sharp check, and prices came down with a jerk—due principally to the German outrage upon the *Arabic*, with its consequent loss of American life. Nevertheless, the Stock Exchange has firmly made up its mind that the United States is not likely to be drawn into the struggle—at all events, so long as she is making handsome profits out of munition orders; but apparently the apprehension of diplomatic relations being broken off between Washington and Berlin has been sufficient to scare some of the American gamblers, who have carried up munition prices to inflated levels.

In the Electricity Supply market, falls of 5s. have taken place in City of London ordinary and in Westminster preference, the price of the latter being reduced to 4¼. It is only when orders come in that prices get a practical test at all; so that the offer of a few Westminster preference at 4¼, finding no immediate buyer, had the effect of putting the price down, just as others would probably give way if shares came to market. A well-known dealer in industrials put the case succinctly when he declared that all the 4 per cent. debenture stocks should be lowered to 80, the 4½ per cents. to 90, and preference shares to a standard at which the return would be approximately 5½ to 6 per cent. on the money. This generalisation is somewhat sweeping, but will probably be found to come true enough during the progress of the war. To return 5½ per cent. on the money, a £1 share would have to stand at 18s. 1½d., from which quotation other calculations can be easily worked out.

Great Northern Telegraphs are 2 higher at 35, but the rest of the Telegraph group is a trifle undecided. Eastern ordinary lost a point, and Globe ordinary at 9½ shed their improvement of the previous week. The hurricane in Jamaica has had no effect upon the cable market. The activity in Marconis has not been resumed, although the price of the shares keeps very firm at 39s. 6d. In consequence of the fall in American rails and "war specials," the price of Amercian Marconis dropped to 17s. 6d., from which there has been a small recovery. Canadians are scarcely moving, the price keeping about 6s. 3d.; while Marconi Marines are a shade harder at 24s. 6d.

At the meeting the other day of the Victoria Falls & Power Co., the chairman spoke with a cautious optimism, which had a strengthening effect upon the price of the shares. The preference continue to be done about 15s. 9d., and the 5½ per cent. second debentures at 85¾. At this price, the last-named pay £6 8s. 3d. per cent. on the money. There is a little business doing also in the ordinary at about the previous price of 4s. 9d.

Foreign electric issues are mostly easier again. Definite steps are still lacking in the direction of pacifying the Mexican chaos, so that the warning held out here against putting too premature a trust in peace rumours has, unhappily, proved to have been justified. Mexican Tramways first mortgage bonds lost 5 at 45, and the other Mexican descriptions have "dried up," to use the market colloquialism. Anglo-Argentine Trams have again suffered, though the 5 per cent. debenture stock is a point higher at 72; the first preference shares slid back to 3⅞.

The Northern Light & Power Co. is having its affairs overhauled on the spot at Dawson City by a member of the Stock Exchange; and it is quite possible that the concern may be set upon its legs once more, under his able direction. Canadian General Electric 7 per cent. preference stock is attracting some little attention at 107; and Shawinigan Water rights are dealt in pretty frequently every day, on the basis of ¾—1.

British Electric Traction stocks are changing hands at about 75 for the 6 per cent. preference, 44 for the 7 per cent. preference, 12 for the 6 per cent. preferred ordinary, and 8½ for the deferred; while the first debenture stock is nominally 78 and the 4½ per cent. second debenture stock remains at 60. London & Suburban Traction ordinary were dealt in a few days ago at 1s., and the 5 per cent. preference at 6s. 9d. In other Home tramway descriptions there is little doing. Brazil Tractions have gone back a little to 48½, on a shrinkage in the Rio rate of exchange; the 6 per cent. preference shares are steady at 85.

The Manufacturing group is firm. Callender's and Henley's debenture stock have been marked down to 92, and will probably shed two or three more points before they attract support. It is in cases such as these that a 4½ per cent. debenture stock has to be valued, in the light of the War Loan standard, at about 90, whereat the return on the money is the round 5 per cent. British Insulated ordinary are still offered, and the quotation is lowered nominally to 10⅝, although bids are wanted. Apart from these, the market is generally good. Electric Constructions were inadvertently marked down to 11s. in our lists of last week, the shares being confused with those of another company. The present quotation is firmer at 13s. British Westinghouse preference 1s. 6d., and various other shares connected with this market are distinctly on the mend. At the same time, it must be said that business is quiet and that public interest remains on a small scale. Babcock & Wilcox keep about 23s. 9d. The armament group on the whole is dullish, inclined to bend a little here and there. So far as rubber shares are concerned, orders are on a scale too limited to affect prices to any extent. The price of the raw material is the merest shade under 2s. 5d. per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Aug. 24, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	8	—	£6 5 0
do. 7 per cent. Pref.	7	7⅞	—	4 10 4
Charing Cross Ordinary	5	4 xd	—	6 5 0
do. do. do. 4½ Pref.	4½	4 xd	—	5 12 6
do. do. City Pref.	4½	3⅞	—	5 16 2
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4⅜	—	5 14
do. 4½ Deb.	4½	88	—	4 17 10
City of London	9	12¾	— ½	7 1 6
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10½	—	6 13 4
do. do. 6 per cent. Pref.	6	10½	—	5 14 3
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	86	—	5 6 0
Kensington Ordinary	9	6½ xd	—	7 4 0
London Electric	4	1⅝	—	8 3 4
do. do. 6 per cent. Pref.	6	4½	—	6 6 4
do. do. 4 Deb.	4	80	—	5 0 0
Metropolitan	8½	2⅜ xd	—	6 7 3
do. 4½ per cent. Pref.	4½	3½	—	6 0 0
do. 4½ Deb.	4½	90	—	5 0 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6⅜	—	7 8 2
do. do. do. 7 per cent. Pref.	7	6½	—	5 12 0
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅞	—	6 19 0
South Metropolitan Pref.	7	1⅛	—	6 4 5
Westminster Ordinary	9	6⅜	—	6 18 4
do. 4½ Pref.	4½	4½	— ½	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	98	—	6 2 6
do. Def.	1½	21½	—	7 1 2
Chile Telephone	8	6⅜	—	5 18 5
Cuba Sub. Ord.	5	8¼	—	6 1 3
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	11	—	*7 5 6
do. 4 Deb.	4	79	—	5 2 1
Eastern Tel. Ord.	7	115	—1	*6 19 6
do. 8½ Pref.	8½	70	—	5 0 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	9½	— ½	*7 4 4
do. Pref.	6	10	—	6 0 0
Gt. Northern Tel.	22	35	+2	6 5 9
Indo-European	10	60	—	6 10 0
Marconi	10	1⅜	+ 1/32	5 1 6
New York Tel. 4½	4½	99	+1½	4 11 0
Oriental Telephone Ord.	10	2	—	5 0 0
do. Pref.	6	1⅛	—	5 6 8
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅞	—	*8 6 6
do. Pref.	6	4⅛	—	5 2 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	11½	—	*6 19 0
do. 4 Deb.	4	81	—	4 16 5
Home Rails.				
Central London, Ord. Assented	4	72	—1	5 11 1
Metropolitan	1½	23½	—	5 6 5
do. District	Nil	14	—	Nil
Underground Electric Ordinary	Nil	1½	—	Nil
do. do. "A"	Nil	5/9	—	Nil
do. do. Income	6	74	— ¾	*9 5 0
Foreign Trams, &c.				
Anglo-Arg. Trams, First Pref.	5½	87	— ⅛	7 1 11
do. 2nd Pref.	5½	8⅛	—	7 17 2
do. 4 Deb.	4	71	—	5 12 7
do. 4½ Deb.	4½	72	—3	6 5 0
do. 5 Deb.	5	72	+1	6 19 0
Brazil Tractions	5½	48½ xd	— ½	7 2 10
Bombay Electric Pref.	6	10½	+ ¼	5 17 1
do. 4½ Deb.	4½	87	—	5 3 0
Mexico Trams	Nil	33	—	Nil
do. 5 per cent. Bonds	—	45	—5	Nil
do. 6 per cent. Bonds	—	35	—	Nil
Mexican Light Common	Nil	25	—	Nil
do. Pref.	Nil	30	—	Nil
do. 1st Bonds	—	40	—	—
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0
do. 5 Deb.	5	98	—	5 2 0
Manufacturing Companies.				
Babcock & Wilcox	14	2⅜	—	6 8 5
British Aluminium Ord.	5	1⅞	—	4 14 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	10⅝	— ⅛	7 1 9
do. Pref.	6	5⅞	— ⅛	5 2 2
British Westinghouse Pref.	7½	3½/6	+1/6	9 7 6
do. 4 Deb.	4	68	—	5 14 4
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11	—	6 16 4
do. 5 Pref.	5	4½	— ¼	5 11 3
do. 4½ Deb.	4½	92	—3	4 17 9
Castner-Kellner	15	8½	—	4 12 6
Edison & Swan, £3 pd.	Nil	1/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	13/-	+2/-	9 4 8
do. do. Pref.	7	19/-	—	7 7 4
Gen. Elec. Pref.	6	9½	—	6 6 4
Henley	20	14	—	*8 3 3
do. 4½ Pref.	4½	4⅛	—	4 14 9
do. 4½ Deb.	4½	92	—3	4 17 9
India-Rubber	5	8⅝	—	5 14 3
Telegraph Con.	20	31	—	7 15 0

* Allowance made for dividends being paid free of income-tax.

Ryland's Electro-Plating Co., Ltd. — The report states that, after making the requisite provision to cover discounts on outstanding accounts, bad and doubtful debts, &c., the profit for the year is £41. The directors regret that the year's trading has resulted in such a small profit, but considering the special circumstances they trust the shareholders will not be disappointed. —*Financier.*

LAMP AND LIGHTING DEVELOPMENTS IN THE NEAR PAST AND FUTURE.

By L. CROUCH.

(*Concluded from page* 228.)

Tungsten lamps have made concealed or indirect lighting on various systems economically possible and, particularly in the case of half-watt lamps, practically essential for interiors owing to the high brilliancy of the source. Purely indirect lighting gives extraordinary uniformity of illumination and absence of shadows—to a degree which is not obtained in any other system of lighting and which is, in the writer's opinion, neither desirable nor agreeable for ordinary purposes. A certain percentage of diffused direct lighting greatly increases the efficiency and utility of the lighting, and certainly makes it more lively and less oppressive. Psychological effects vary with every subject, but most people appear to experience a more or less depressing effect from entirely indirect lighting and a sense of being confined and "on show." The lighting obtained may resemble daylight very closely in diffusion and colour, but no one would for a moment think that the lighting was really natural.

This raises the whole question of whether perfect uniformity of lighting and "daylight effect" is really desirable in ordinary interiors by night. For any work involving colour matching it is, of course, essential, and artificial daylight can be approached more accurately the more one is willing to spend on light wasted in special colour filters. Perfect uniformity of lighting is not natural; it is essentially artificial, and to most people it is more or less depressing and certainly not restful. The only completely successful way of imitating daylight illumination (assuming the latter to be worth imitating, which it is not always), is to allow artificial and natural light to enter by the same openings, the amount and quality of each being the same. The cost of such artificial lighting is usually prohibitive.

Closely associated with the effectiveness of lighting is that of colour. The number of strongly coloured light sources is so limited that outspoken remarks are apt to be given an application which is not intended. Yellowish and rosy light is the most suggestive of ease and comfort, and there is every reason to support the common preference for these tints, for artificial lighting in streets and homes is generally required during hours when most people are "off work." The cold light of efficiency is naturally more appropriate to offices, shops and workshops. On going towards the blue end of the spectrum, colours become (to the writer at least) more depressing and finally produce a sort of aggressive morbidity. Undoubtedly yellow-green light is that to which the human eye is most sensitive, but its psychological effect is not pleasant. It is well expressed by a line in a certain book on stage effects—"For weird or murder scenes—green light!"

The high intrinsic brilliancy and mechanical concentration of source in tungsten lamps makes the latter eminently suitable for a variety of optical applications, such as lighthouse, motor-car and locomotive projectors, "magic" lanterns and cinematographs, signalling purposes and examination by translucence. The efficiency and almost point-focussing of small half-watt lamps undoubtedly gives them a great future in all of these applications, and in headlights for motor-cars, the smallness of the source should favour the elimination of dazzle by baffle disks, partial obscuration of bulb and so on.

Progress is slow in our endeavours to secure high efficiency lamps of low intrinsic brilliancy. Useful as the principle of intermittent, super-incandescence (applied a year or two ago by a certain French scientist) may be in special signalling, photographic, cinematographic and other services, it does not provide a cold light, and its limiting efficiency would appear to be necessarily less than that which can be approached in gas-filled tungsten lamps (as they are worked nearer the melting point of tungsten) owing to the loss in intermittently heating and cooling a number of filaments which cannot, under any circumstances, be worked even momentarily above that limiting temperature.

Much is still to be hoped for from tube lamps, and something in the way of a super-Geissler tube would fulfil most of our ideals. The mercury lamp is far from a cold light, and in its latest form—the quartz lamp—it follows the trend of all incandescent lamps towards higher temperatures and more intense incandescence. The green mercury arc seems to have a field of permanent utility in photographic work and as a rectifier. The quartz lamp is undoubtedly valuable for sterilising purposes (though recent researches with the oscillating spark threaten its position in this field), and, as an illuminant, it has good industrial prospects, particularly for direct connection to 400-600-volt circuits (in conjunction, possibly, with iron wire variators steadying the terminal P.D.).

The Moore lamp does not seem to gain the popularity to which its merits entitle it. On the plain basis of watts per candle, it is not an efficient lamp, but, allowing for all losses, an overall consumption of 1·5 to 1·7 watts per C.P. is obtainable, and this compares very favourably with the corresponding *overall* efficiency of most direct and semi-direct systems using high efficiency lamps in conjunction with such fittings as to produce diffusion and soft shadows comparable with those of the tubular lamp, which yields only 50 C.P. per yard run as against 450 C.P. for the neon and 1,000 C.P. for the mercury lamp. Three-phase lamps can be conveniently arranged. The writer believes that careful quantitative investigation of the possibilities of the Moore lamp is well worth while in a variety of services. In lighting facades, long corridors and large rooms it gives excellent results well worth a slight sacrifice in efficiency.

The neon lamp has the advantage of higher efficiency, lower working voltage, and smaller electrode loss (making practicable shorter tubes). Its intrinsic brilliancy is considerably greater than that of the Moore lamp, but still very low, and consumption down to 0·5-0·6 watt per spher. C.P. is claimed as overall efficiency. The light is entirely deficient in blue rays, which makes it very useful for photographic "dark" rooms where plenty of non-actinic light is required. It may yet prove possible to blend satisfactorily light from neon and mercury lamps, but the rosy light of the neon lamp is one of the most acceptable monochromatic lights for many classes of interiors.

The chief obstacles in the way of tube lighting on low brilliancy systems are: (1) The first cost of installation, which should be reducible; (2) relatively low efficiency in candles per watt, which efficiency is materially increased when overall efficiency from supply mains to eye is considered; (3) considerable length of lamp necessary to reduce the specific importance of the electrode loss. In the latter respect neon lamps are much superior to the Moore type, and there is no reason to suppose that yet better results cannot be obtained. If it be attempted to get really extensive application of tube lamps, a service would probably have to be organised to clean and refill them *in situ*, at intervals. This need not be a costly matter; indeed, it should reduce maintenance costs to an unprecedented level.

Supposing that they enjoy no wider field, low brilliancy tube lamps are likely to find increasing application in advertising, decoration and display lighting of all kinds, and it would be a pity were their possibilities overlooked till too late by firms in this country. Some 50 years ago experiments were carried out in lighting mines by Geissler tubes, and it does not seem improbable that modern tube lamps could find very useful application in this service, at any rate, in the main galleries of pits.

Drawn wire is established standard material for tungsten-filament lamps; there is little left to desire in its mechanical strength and durability in service, and by following present lines of development, we may hope to approach 0·33 watt per candle efficiency, corresponding to the melting point of tungsten. The working temperature of the present half-watt lamp is about midway between that of the ordinary tungsten lamp and the melting point of tungsten. Due to the direct and definite connection between filament dimensions, resistance and candle-power, low voltage supply is inherently more favourable than high voltage to filament lamps in respect of durability and efficiency. Vacuum tungsten lamp manufacture has been so far perfected as to remove the disabilities of high voltage lamps in these respects almost completely, and the use of auto-transformers is only per-

sisted in in odd cases. Where still used their light load current costs the consumer more than his saving on load, as compared with high-pressure lamps (unless he puts up with the appreciable inconvenience of switching out the transformer last thing at night*), and the effect of a number of auto-transformers on the power factor of a lighting network is very objectionable.

Although the auto-transformer is obsolete as an accessory in ordinary tungsten lighting, there is likely to be a marked recrudescence in its use with half-watt lamps. It may fairly be assumed that a big demand for 200 and 100-C.P. gas-filled lamps will arise in the next few years—probably soon after the declaration of peace and directly lamp manufacturers start the demand by advertising the possibilities of such lamps. At present manufacturers are taking no steps to "boost" the low candle-power half-watt lamp (much to the relief of central station engineers!), but the time will come, and may come soon, when the demand for such lamps will rise rapidly and irresistibly.

At present 50 and 100-C.P. half-watt lamps are available only up to 10 or 20 volts,† and if auto-transformers be used at the distribution box, wiring troubles are in store. A house wired none too liberally for carbon-filament lamps can employ 1-watt lighting with a large factor of safety, but, even at 25 volts (which represents the probable limit of voltage for 50-100-C.P. half-watt lamps for some time to come),† the current to be carried is 1½ to 2 times as great as for 200-250-volt carbon lamps of the same candle-power, and 5 times as great as for corresponding 1-watt lamps. The position is that wiring troubles are ahead, if fractional reductions in watts per candle are obtained at the cost of lower working voltage and auto-transformers are used to feed a wiring system designed closely for use with lamps of somewhat poorer efficiency but considerably higher voltage. Consumers on low voltage A.C. systems will be the first to benefit (and their station engineers the first to suffer) by the extensive use of half-watt lamps in domestic lighting. When so used these lamps must, of course, be half frosted, or used in an appropriate diffusing fitting, but there is no difficulty therein, and the writer believes that half-watt lamps will be used extensively in small interiors (from A.C. supply) directly the makers care to start the ball rolling.

The wiring difficulty and the poor power factor of ordinary auto-transformer installations can be overcome by using a small auto-transformer for each lamp, mounted near the latter and forming part of the local switch circuit. Under the name "reductor," such auto-transformers are much better known on the Continent than here. The writer believes large numbers will be used in connection with low voltage half-watt lighting, and that it would be worth our while to take up their manufacture and marketing.

But very little, if any, low-pressure wiring is required where reductors are used, and the transformer is only in circuit when operating on full load; power factor from 96 per cent. to practically unity is then obtainable according to wattage of the apparatus. For ordinary tungsten lamps, reductors have often been incorporated in the lamp-holder, but this is undesirable for half-watt lamps, owing to the heat developed by the latter. If circumstances call for the use of a number of sizes of lamp, the high candle-power units may be connected directly to the mains and reductors (not necessarily all for the same secondary pressure) used with the smaller units. Already there are available 1,000-5,000-C.P. nitrogen-filled lamps for direct operation on pressures up to 240 volts. Lamps of 400 C.P. are available up to 130 volts,† but 10 per cent. saving in consumption is effected by working at 25-60 volts. For 200-candle-power lamps, a reductor giving a secondary pressure somewhere between 15 and 50 volts is suitable; for 100 C.P., between 10 and 20 volts, and for 50 C.P. only 6 or 8 volts. There is no apparent obstacle to the wholesale use of such lamp and reductor combinations, and it would be worth while installing a small converter in many cases where D.C. supply is alone available.

* The writer has the privilege of knowing several careful people who habitually switch off at the main each night and go to bed by candle-light.

† The above article was written prior to the advent recently of new sizes of both high and low-voltage half-watt lamps, referred to in our issue of July 9th; 60-C.P. 50-volt, 120-C.P. 100-volt, and 200-C.P. 200-volt lamps are now available.—Eds. Elec. Rev.

There are two categories in which reductors should be specially useful: (1) Shops, &c., where best results are desired from 600-1,500-C.P. lamps. (2) Small users wishing to realise the economy of half-watt lamps in 50 and 100-C.P. units. The shopkeeper could use reductors of ½-1-KW. output measuring 6 to 9 in. all ways, weighing 20-25 lb., and giving a secondary pressure of 50 or 60 volts. Though only 3 to 5 per cent. loss would occur in transformation, which loss would be covered by the higher lamp efficiency and greater filament strength, it is doubtful whether the relatively costly and heavy reductors required are worth using, since surprising guarantees are already given with the higher candle-power high voltage half-watt lamps. The second case is, however, very different. Small candle-power half-watt lamps are available only for 20 volts and under, and suitable reductors for 25 to 150-C.P. lamps measure 2½ to 4 in., and weigh 1½-2 lb. for 50 C.P. up to 4 or 6 lb. for 200-C.P. lamps. About 10 per cent. loss occurs in transformation, but an overall efficiency of 0·6 watt per candle can be secured, and this is worth the cost of the reductor, which requires no special installation or wiring alterations. A 10 or 20-volt half-watt lamp is quite a robust article, and it is likely to be some time before 50 and 100-C.P. units are available for higher pressures.

Filament lamp manufacture is now in the hands of a limited number of manufacturers—with great advantage in price and quality to the consumer. So considerable is this advantage that it would be ungrateful to lay too much stress on the use of watt ratings instead of candle-power and other little matters in which manufacturing convenience and not public preference is the predominant factor. After all, it is only by this means that so good and cheap lamps are available, and in the particular case of "watts *versus* candle-power rating," the number of sizes are so numerous that the changing C.P. of various wattages can usually be covered nearly enough by the use of another wattage.

There is, however, a risk that where lamps are sold by wattage, a man will go on using, say, a 50-watt lamp long after the candle-power obtained from that wattage has become objectionally high.

The voltage at which filament lamps are operated affects the degree of realisation of the whole of the maker's rating—life, efficiency, candle-power, and watts. An admirable example of the dangers of a little knowledge is to be found in the case of the layman who, being advised some years ago to buy lamps for 5 volts higher pressure than the service volts, continues to do so to this day. At one time fairly good policy, the practice is now unnecessarily wasteful in light efficiency. If the service pressure be below rated, the effect is the same as if the consumer buys an over-voltage lamp, and if both conditions exist together, there is soon a dissatisfied consumer. Many central station engineers still overlook the fact that, where *energy* meters are used, low supply voltage means proportionate loss in revenue; if only ampere-hour meters are used, it means corresponding gain.

A matter in which the interests of all parties coincide is that of the three voltage rating of lamps. Central stations continue to be erected at an extraordinary rate in this country (unfortunately often to gratify parochial pomposity where bulk supply from an adjoining area is dictated by every other consideration). In either case—whether generating or transforming down from a H.T. line—it would be very advantageous from the lighting point of view to keep off 100, 110, 200, 220 and other "overcrowded" pressures. By arranging supply at 105, 115, 205 or 225 volts, lamp manufacturers could be given a means of economising manufacture and benefiting consumers thus directly, and also by closer and more uniform rating.

Problems connected with the home supply of lamp-cap stampings, glassware of all kinds, and other lighting materials and accessories, have already been dealt with in these columns. The standardisation of small lamp manufacture is a reform which has been slowly developing for some time past, and which ought to take definite shape at this juncture. There is no reasonable justification for the present multiplicity of voltages, candle-power, filament arrangements, bulb sizes, and so forth. One of the most interesting and valuable applications of small filament lamps is to miners' hand lamps. Some types on the market, though

conforming to Home Office requirements, are obviously foredoomed to failure. Though the official tests are severe, they do not discriminate completely between lamps which are a sound engineering job and those which, as a whole, are not.

On the other hand, certain of the official tests, particularly the apparently crude dropping tests, are often ridiculed, though they approximate closely to misuse, which may easily arise by carelessness or accident. With hundreds of lives literally depending on the prevention of a spark, one should not hesitate to insure against the grossest misuse or folly. Ribbed or corrugated cases of anti-corrosive steel alloy are likely to become standard, and though there is still room for advance in battery construction, it is the charging and testing arrangements which make much of the difference between success and failure in wholesale practical application. Not the least of the advantages of electric lamps for miners is the possibility of switching off all but one or two lamps in the event of a number of men being imprisoned by a fall, so that, by using lamps in turn, instead of all at once, the horrors of darkness are not added to the victims' ordeal. To prevent use of such a switch (and consequent irregular discharge of the various batteries), except in case of emergency, a simple lead seal may be provided, so that the switch will only be used when really necessary.

In concluding these somewhat disjointed remarks, the writer trusts that due attention will be paid to some at least of the problems and developments he has mentioned, before regular routine is again adopted in the lighting industry.

BRITISH ELECTRICAL TRADE WITH EGYPT.

By "ANGLO-EGYPTIAN."

The present war has disorganised the majority of our electrical manufacturing concerns. The export of supplies is curtailed; stocks abroad are becoming depleted and, in the present circumstances, are difficult to replace. At the termination of hostilities a rush for electrical supplies may be anticipated. Stocks must be replenished, temporarily discontinued works will be resumed, and many important schemes awaiting the opportune moment will be embarked upon. Foreign competitors will be shut out of our Colonial markets, and British manufacturers will lay themselves open to take advantage of the new commercial situation from which they alone should reap the benefits.

Amongst others of the overseas markets which are already looked upon with an optimistic eye, is Egypt, which has hitherto been largely exploited by the important German and Austrian electrical houses, and also in a measure by the French; indeed it may be truthfully stated that during the last 10 years only a very small percentage of the total electrical material which has been imported into that country has been manufactured in Great Britain. For this sad state of affairs I am prepared to say that the fault largely lies at home.

Let "by-gones be by-gones," and let us prepare for the future, for the time will come when we may start afresh without the fear of foreign competition, as it is to be assumed that home competition alone will have to be dealt with. One must not, however, lose sight of the fact that practically the same circumstances will govern the conditions under which business will be carried out in the Egyptian market, the difference being solely that foreign competition will be eliminated.

I trust that in making this latter statement I shall not be regarded as too optimistic, for is it not one of the great great advantages that we are fighting for at the present moment? It is but a natural sequence to the satisfactory termination of the war.

As to what steps the enemy will take to circumvent this I am not prepared to say. But if one may judge from the thoroughness of their business methods, and the results obtained by them in the past with regard to our Colonial markets, we may safely anticipate a revival of their business tactics after the war.

Various English electrical manufacturing companies have already announced their intentions of slipping into the breach caused by the recession of their antagonists from the Egyptian market. Several of these concerns are capable in all ways as regards manufactures, of supplying fully the requirements in that part of the world. But there are few amongst them who manufacture the complete range of electrical supplies catalogued by such firms as the A.E.G. and the Siemens combinations. And there are fewer still who have brought to bear upon the Egyptian market that system of organisation and thoroughness of business methods which have won for them practically the whole of the Egyptian trade. I speak with some knowledge of the Egyptian Government and other contracts which have been placed during the last 10 years, and I have in mind, in nearly every case, the reasons why contracts were awarded to foreign firms in preference to British manufacturers.

The question which now arises is this: What was the reason for our failure in the past? The answer is that it was simply a question of price and organisation—two words which count enormously and which have a paramount influence in a sales department. In the majority of cases where British manufacturers have failed to capture Government contracts during the last nine years, I am of opinion that it may be attributed to one of the two foregoing reasons. Excessive cost may be traced to defective organisation as regards want of intimate knowledge of the market in which the goods were to be sold. The following will explain this fully.

Government tenders as regards electrical plant usually call for the plant to be erected on site and handed over in working order.

Payments are effected partly against shipping documents erection and tests on site, the balance, which is usually 20 per cent., being paid after satisfactory working for, say, three months, or other pre-determined period.

It is feasible to believe that it is in the unknown factor that the manufacturer meets his pitfalls. That is to say, he is in many cases at a loss to define correctly his real expenses after the goods arrive at the unloading port, which is usually specified as Alexandria. To meet this deficiency he covers his estimate with a margin which would be unnecessary if he understood thoroughly the procedure and numerous items of expenditure to which the goods were subject on landing; in addition, the intricate questions of supervision, labour, railway freight, cartage, cost of excavation and materials for erection, all generally form very important items in the estimate.

These difficulties may be met by the appointment of a reliable and experienced commercial engineer as agent, who should assume responsibility for all goods after their reception at the unloading port. In this manner the home estimating office will calculate all charges up to and including c.i.f. Egyptian port, and will call upon their agent for a supplementary estimate concerning Customs' duty, dock dues, inland freight, if any, cartage to site, storage, also supervising expenses, excavations, labour and materials, if the plant is to be handed over in running order. The usual procedure is for the agent to sublet the contract for excavations, foundations and brickwork. These vary considerably, depending upon the locality and cost of materials. In the case of large and important plants it is advisable to send out a supervising erecting engineer. Less important erections may be carried by European erectors, whose services can be obtained locally at an expense of £12 to £20 per month, depending upon the capability of the individual. Assistance in the shape of Italian or Greek assistant engineers may be secured at £5 to £6 per month, but they are rarely to be relied upon for very accurate work, such as erecting engines, &c. Native labour is to be had for £3 to £4 per month, but workers of this class are little better than labourers.

German, Austrian and French competitors go further than this. With the exception of the A.E.G., who do business through a firm of old-established agents having branches at Cairo and Alexandria, such firms as Siemens and Halske, Siemens Schuckert, Ganz & Co., and the French Thomson-Houston Co. are represented by branch house

under the control of technical commercial managers, aided by competent staffs. Each branch comprises also a retail department replete with large stocks of all classes of electrical supplies. Expenses are paid by retail sales and small contracts for electric light and wiring installations. The bulk of the stocks are on consignment, and are paid for in accordance with arrangements made with the parent firms.

It seems, that with the exception of a few firms in this country who manufacture a complete line of electrical supplies, the branch system of doing business would be inadvisable on account of the diversity of material required to maintain an efficient stock. An easy method of getting over this difficulty would be for a number of firms to collaborate for opening a branch and subdivide the expenses and profits in accordance with their proportionate interests.

If it is desired to cater only for the requirements of the various Government departments, then a local agent residing at Cairo is all that is necessary. Here it may be stated that all Government contracts involving machinery to be erected entail an agent with a local address. If, on the other hand, a general electrical engineering business is sought in addition to Government requirements, an agent carrying a complete stock of supplies, or a branch house, is necessary.

The representative must be of good address and calculated to make himself acceptable to such Government officials as he will interview in the course of business. English is the official business language in Government circles, whilst the metric system is principally employed for weights and measures. A knowledge of French and Arabic is also necessary in Egypt, the use of the latter language being absolutely essential in the Provinces.

It may be useful to terminate these notes by giving some idea of the present situation in Egypt as regards our competitors. At the commencement of hostilities the British authorities carefully segregated the German and Austrian branches from their parent houses. The A.E.G. agents discontinued their representation and opened up negotiations with an important English manufacturing concern.

The management of the Ganz & Co. and of the Siemens branches was taken over by certain of their English and Swiss employés. This step was taken with the approval of the British authorities who exercise control over their financial transactions.

Goods of proved enemy origin coming into Egypt through neutral countries are confiscated, so that there is no possibility of stocks being replenished from sources which are prejudicial to British interests.

THE USE AND ABUSE OF OILS ON MINING PLANT.

By T. C. THOMSEN, B.Sc.

(*Abstract of paper read before the* Association of Mining Electrical Engineers.)

The owners of many large plants have seen the advantage of having an engineer responsible for the lubrication of their engines and machinery, and in plants which are not large enough to justify the employment of an engineer for this particular work, it has been found advantageous to have a lubricating engineer to inspect the plant occasionally, report on the lubricating conditions, and offer suggestions as regards economy and saving in power.

Many important institutions controlled by Government, or large concerns, also electric supply authorities, when inviting tenders specify certain chemical attributes in the oil. This practice is wrong, because chemical readings do not show the lubricating properties of an oil, for the reason that it is possible to duplicate a high-grade oil on the basis of chemical tests by means of an imperfectly manufactured and inferior article. Although the chemical tests may be the same for the two oils, the results can be widely different in actual work.

The only accurate way of testing lubricants is to try them under working conditions, where they are to be actually used.

The question might be asked whether introducing a higher grade of oils would not increase the total cost of lubrication. In reply, experience has proved that in a large number of plants the costs of lubrication over a period may even be lower than with lower grades of oil in use. In other cases the cost may possibly work out a little higher, but this increased cost will be balanced by other benefits. It is here that the services of a lubricating expert become desirable. He should select high-grade oils for the portion of the plant where such oils could be used to advantage, and if the lubricating conditions are not favourable to the introduction of high-grade oils, he may suggest ways and means by which better lubricating appliances or better methods of handling the oil can be introduced, so as to make the introduction of better grades of oil possible.

When talking to men directly interested in the successful running of machinery, one is often assured that they have no trouble; the idea being that the machinery is operating without any unusual heating of bearings or engine parts. In many such plants, however, the mere change from low-grade oils to better grades has effected a saving in power of 20 per cent., and it is now realised that there is something beyond having "no trouble."

A troublesome bearing in nine cases out of ten will not indicate that the oil is unsuitable, but that some mechanical defect exists in its construction. It is not an occasional hot bearing, but the few degrees of unnecessary frictional heat that are wasted in hundreds and hundreds of bearings that determine the real standard of lubrication.

The actual testing of the influence of better lubrication on the power of mining machinery or power-house plant is a difficult matter, as there are so many other conditions that may influence the results.

By means of accurate temperature tests it is, however, possible in nearly every case to make a comparison between the lubricating qualities of different oils, and it is recommended to make such tests as thorough and as careful as possible on specially selected important bearings. These temperature tests should be repeated from time to time, with a view to controlling the quality of the oils in use. If the mechanical conditions do not change, the rise in temperature of the bearings above the surrounding atmosphere should remain very nearly constant.

When a new motor exhibits a tendency to develop heat in one bearing, the bearing should, of course, be examined. If it is found in good condition, the cause of the heating will probably be found in the thrust of the armature shaft against the bearing, which may result from either of two conditions: First, the machine may not be level and the armature shaft may dip towards that end. Second, the magnetic centres of the pole-pieces and armature may not be in line.

Where low-grade mineral oils, or oils with mineral base but compounded with animal or vegetable oils, are employed they will develop gumminess in the bearings, and necessitate frequent cleaning. Such cleaning is unnecessary when high-grade dynamo oils are employed; cases have been known where such oils have been in use for years without any necessity for cleaning the bearings and oil wells. However, it is desirable to empty the bearings every three or four months, and put the oil through a suitable filter. It will then be as good as new, and can be used over and over again, being mixed with a little fresh oil to make up for loss.

The leakage of oil from a ring-lubricated bearing may be due to several causes. Sometimes oil leaks through the horizontal keep joint of the bearing. The best remedy for this is to place a lead wire as packing in the joint. Bearings on large motors and generators often have a deep groove in the bottom half of the bearing, which groove, at both ends, communicates with the oil reservoir and returns such oil as may have reached the joint by splashing out from the well through the motion of the lubricating rings.

Sometimes leakage will be observed along the shafting. It is important that there should be a good clearance between the outer lip and the shaft, and if it is too close a fit it should be eased.

If the oil still has a tendency to creep along the shaft, an oil-thrower can be made in halves and fitted on the shaft, or it may simply be a piece of steel wire bent round the shaft and clinched so that it will keep its position. Grooves in the bush will arrest the greater part of the oil, whilst the remainder is thrown off the collars. The keep may be fitted with an internal lip, which prevents oil splashing out through the joint.

Ring lubrication is very effective, as the oil is continuously lifted by the ring or the rings over the shaft, and finds its way into the oil-distributing groove, whence the film of oil between the shaft and the bearing is kept amply renewed. Care should be taken that the oil-carrying grooves are well rounded in the direction of rotation, to facilitate the entrance of the oil between the frictional surfaces. If the motor is built to rotate either way, it is necessary to have two oil-carrying grooves, one on each side of the centre line.

Sometimes lubricating chains are employed instead of lubricating rings, the idea being that the chains touch the shaft through a longer arc, and, therefore, are supposed to be kept in motion more surely than plain rings. It must be remembered, however, that the part of the chain immersed in the oil bath offers greater resistance than a plain ring, so that in actual practice there is not much difference between the working of chains and the working of rings. At high speeds there is the disadvantage with chains that the links, when passing through the oil, churn it up. This makes it more difficult to prevent leakage of oil from the bearings.

Satisfactory lubrication of dynamo bearings, *i.e.*, cool running and inappreciable wear, is very important. If wear takes place, this means that the rotor is lowered, and the magnets will then exert a pull on the rotor in a downward direction,

which further increases the pressure and accordingly the wear of the bearings.

The question of the internal lubrication of steam engines is of great importance. Nothing is more capable of destroying the good effects of high-grade cylinder oil than applying it in a wrong manner, or through unsuitable lubricators.

The tallow cup still used by some firms generally feeds the oil direct to the cylinder or to the valves, or to both places. When the tallow cup is filled with oil and the dose thrown into the engine, most of it is exhausted at once. Then the engine runs on what little oil may be left and, after a few minutes, it is running without any oil until such time as a new dose is given. It has been found that the steam itself, which goes from the steam main into the engine and touches every part of the frictional surfaces, is the best medium to carry the oil to the places where it is needed.

It is important, however, for the steam to be impermeated with the oil. This can best be done by the use of an atomiser. Fig. 1 illustrates a form which was designed by the author, and of which about 10,000 are known to be in regular use. It has been freely copied by engine builders and others, not being patented. The cylinder oil will enter the spoon-shaped open

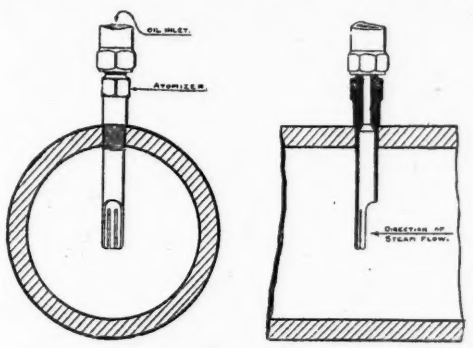


Fig. 1.

end of the atomiser, which is placed in the centre of the steam pipe, where the velocity of the steam is greatest, and every drop of oil which appears in the open end will be broken up into small particles, and be distributed in the body of the steam, making the steam itself a lubricant. The steam, on its way through the engine, will therefore carry along particles of oil which will come in contact with all surfaces needing lubrication; and, assuming that the cylinder oil is a good one, specially selected for the class of work, perfect lubrication will be ensured.

Where compound engines are lubricated by feeding the cylinder oil into the high-pressure steam main, it is quite evident that, as the oil gets thoroughly broken up into the steam, the latter may often arrive at the low-pressure cylinder having sufficient lubricating properties to effect full lubrication. In many cases, therefore, it is not necessary to have oil fed direct to the lower stages.

Where superheated steam is in use, it is absolutely essential that only the highest grade of oil be employed, also that the lubricator should be of a first-class make of the mechanically-operated forced-feed type, capable of furnishing a very sparing and uniform feed of oil into the main steam pipe, the oil being introduced into the central flow of steam, by the means already mentioned. The characteristics of a cylinder oil for use with a superheat should include a fairly high flash-point, and no tendency to carbonisation. On occasions cylinder oil has been used for superheated steam having a flash-point lower than the temperature of the steam, and giving good results. This may appear somewhat contradictory, but the secret is that the flash-point of cylinder oils is determined in the laboratory under atmospheric pressure. If the cylinder oil were to be tested under the high pressure existing in the steam pipe, the flash-point would undoubtedly be shown to be considerably higher, just as the boiling point of water, which at atmospheric pressure is 212 deg. F., increases with any pressure above that of the atmosphere. Furthermore, there is no air in the steam to affect the oil.

Most of the cylinder oil introduced into a steam engine will be carried through with the exhaust steam, and in the case of surface-condensing engines, or where open feed-water heaters are installed, there is a great probability of the oil getting into the boilers, which would decrease the boiler efficiency considerably, and increase the danger of boiler explosion or furnace collapse.

Cylinder oil can be made which will separate readily from the feed-water in the hot well, presenting itself as float oil, which can be skimmed off. Sometimes feed-water filters are installed, which are supposed to prevent the oil from getting into the boilers. These filters are, as a rule, of very little use, whereas suitable-sized oil extractors in the exhaust steam line will, in many cases, extract nearly all the cylinder oil.

Electrical treatment of the feed-water will extract every trace of oil. In the case of jet-condensing engines, the possibility of oil getting into the boilers is very much less than in the case of surface-condensing engines, as the oil is mixed with such large quantities of water.

When the boiler feed-water is hard, and softened by boiler composition, and the boilers "prime," the solid matters carried over to the steam engine will deposit themselves behind the piston rings, in the clearance spaces of the cylinders, and in other places, amalgamating with the cylinder oil and forming deposits, the presence of which is often put down to carbonisation of the cylinder oil. It is true that unsuitable or low-grade cylinder oils may form deposits and carbonise, but in many cases the deposit can be traced back to the boiler conditions.

In combined reciprocating engine and turbine plants it is most essential that the highest-grade cylinder oil be used, in order that the quantity of such oil for the engine lubrication may be cut down, to reduce the chance of oil being passed on to the turbine.

In the forced lubrication system of high-speed enclosed steam engines the oil is forced by a pump under pressure to all bearings, draining back to the oil suction chamber, and in this way circulating continuously. Oils for this purpose should be made to withstand the action of water and air, and must not deteriorate with long use. Water gets into the crank chamber owing to the presence of ill-fitting glands or "scored" rods. Where the rods enter the crank-chamber top, scrapers are preferable to soft packing. The oil which is carried up from the crank chamber and scraped off, together with the water, should be drained outside the crank chamber. Metallic packings are preferable in such engines, as there is less danger of "scoring" the rods than with soft packing.

The oil pump should be of ample capacity, so that the pump pressure, by means of an adjustable relief valve, with an overflow to the oil suction chamber, can be kept at any desired point. Too small an oil pump or slack bearings decrease the oil pressure, or make it necessary to use exceedingly heavy oils, which oils reduce the friction less than might be. The oil pump should be placed with its suction strainer elevated to leave room below for the water to accumulate. Otherwise water is drawn together with the oil into the pump and forced through the bearings, which may cause the oil to thicken. The crank chamber should be systematically drained at suitable intervals. Slightly superheated steam is an advantage, as less condensation occurs in the cylinders; therefore less water finds its way through the glands.

A drain cock of preferably 1½-in. bore, but not less than 1-in. bore, should be fitted at the lowest point in the crank chamber, and if the water can be drained off while the engine is running, this should be done at frequent intervals. Where the draining cannot be accomplished while the engine is running, it should be done before starting up every time the engine has had a rest.

Every plant (this also refers to turbine installations) should have a steam filter, so that from one to six gallons of oil per day (according to conditions) may be removed through the drain cock for treatment in a steam-heated separating tank, and afterwards in a good filter. The purified oil should be returned to the crank chamber at the same time as the corresponding quantity is drawn off for treatment. In this way the vitality of the oil can be maintained at a high standard. If the oil tank capacity in the system is small, it is particularly desirable to follow this treatment. Sometimes a "water-leg" can be fitted with good results to the crank chamber of a steam engine where the leakage of water into the crank chamber is considerable.

Only small turbines, from 5 to 300 H.P., have ring-oiled bearings; larger turbines employ the circulation system. In the circulation system the lower portion of the governor spindle drives a rotary oil pump, which takes oil from the oil tank, and delivers it, through the oil cooler and oil-supply pipes, directly to the bearings, or to an elevated tank. If more oil is delivered to the elevated tank than is required for the bearings, the surplus oil overflows through a pipe into the bottom oil tank.

From the elevated tank the oil is fed through the distributing pipe into the various bearings of the turbine, and having done its work in the bearings—the oil throwers preventing the oil from creeping out along the shaft—the oil returns through the return pipes to the bottom oil tank, through the strainer. The main bearings are frequently cast with inside cavities for water-cooling purposes.

The elevated tank is only used in very large installations. Generally, the oil passes from the oil cooler directly into the distributing pipe; it then becomes necessary to have a spring-loaded relief valve in the delivery pipe, near the bottom oil tank, in order to maintain an adequate oil supply at a steady pressure. The surplus is returned to the bottom oil tank.

It is good practice to insert in the return oil pipes sight-feed arrangements by which the actual flow of oil from each particular bearing can be examined; frequently test cocks are fitted in the middle of the bearing tops, which, when opened, will show whether the bearing is being adequately supplied with oil. In both the elevated oil tank and the bottom oil tank are fitted drain cocks, through which water and sludge can be drained away.

The oil pressure, where the oil is used for lubrication only, varies between 3 lb. and 35 lb. per sq. in. Frequently, the oil is also used for operating the governor gear. For this purpose, oil is introduced into the various parts of the governor gear operated by the oil under a pressure of from 25 lb. to 80 lb. per sq. in. If, for any reason, the oil pressure falls below that required, a piston in the governor gear, held up by the oil pressure, falls and causes the steam supply to be shut off.

Where an elevated tank is employed, sufficient oil is usually assured to lubricate the turbine for at least 30 minutes, should the oil pump fail to work.

Where turbines are lubricated by means of a circulating oil system, the oil is in constant circulation and comes in contact with more or less air and water. In passing through the main bearings, the oil is churned with the air, water and impurities present, with the result that the oil breaks down gradually, due to the high temperature and great speed of the revolving shaft.

The chief cause of water leaking into the oil is usually the gland packing. Steam passes from the gland packings into the main bearings and condenses on their surfaces. In cases of exhaust and mixed-pressure turbines, it is particularly difficult to prevent leakage of condensed steam from the glands to the bearings, and the engine attendant should use great care to keep this leakage as low as possible. Water may also leak into the oil from the water-cooling coils in the oil cooler, or from the water jackets of the main bearings.

Where leakage of water into the oil system cannot be avoided, a water-trap consisting of, say, 4 ft. of vertical 2-in. pipe with a 1-in. drain cock at the bottom, and fitted to the bottom oil tank or main oil return pipe, has been found of great service. The water, circulating with the oil, will separate from it and drain into the trap; once there it cannot mix with the oil again. This water-trap should be drained twice every 24 hours, letting the water and sludge run until clear oil appears.

The drain cocks on the oil tanks should be opened before starting up the turbine, and twice every 24 hours, to remove water and impurities. The suction of the oil pump should be from 4 to 6 in. above the bottom of the oil tanks, as otherwise any separated water will be immediately taken up by the pump, churned with the oil, and passed into the oil system.

It is good practice to have a large quantity of oil in circulation, with large oil tanks in which the oil has time to rest and separate from the air, water, dirt and other impurities it collects in the system.

The continuous circulation of oil in the system results in a final breakdown of the oil itself, due to the action of heat, moisture and air. The evidences of breakdown are, increase in viscosity and gravity, the development of considerable acidity, and the deposit of sludge, or sediment. The length of service of an oil and the character of the breakdown are dependent upon the quality of the oil. An unsuitable oil breaks down quickly and goes to pieces badly. A high-grade oil, under normal conditions, will give good service for 10,000 working hours at least; but under severe and very unfavourable working conditions, for 3,000 working hours at most.

A sample of "broken-down" oil, when heated, will separate into three distinct layers: At the top, clear oil; at the bottom, clear or somewhat cloudy water; between the two, a slimy mixture composed of a number of indeterminate elements. This slime represents the "broken-down" oil, and may be due to its unsuitability or incorrect manufacture, or to some chemical or electrical action on the oil in service.

"Broken-down" oil accumulates in the most dangerous places, namely, the oil pipes which lead the oil from the distributing pipe into the main bearings. Partial stoppage of the pipes may result. "Broken-down" oil also accumulates, as a slime, on the water-cooling coils in the oil cooler, thereby decreasing the efficiency of the cooler; the circulating oil assumes a temperature higher than the normal, which in extreme cases greatly impairs the life of the oil.

If "broken-down" oil forms in the oil pipe leading to the governor, or inside the governor gear, the governor may stick and fail to act; in consequence, the turbine either will slow down gradually, or gradually increase in speed much above the normal.

The parts of the governor gear with which the oil comes in contact are very sensitive, and the oil must be absolutely clean and of high quality to ensure their smooth working. With an unsuitable grade of oil, the bearing temperatures are always high. The rate of oil oxidisation—generated by the great heat—is thus increased, so that frequently the life of an ordinary oil in a turbine is only a few months.

High-grade oil, correctly refined and manufactured specially for turbine lubrication, is less affected by the presence of air, water and other impurities than ordinary oil. High-grade oil clears quickly, and is not so liable to breakdown. It will prevent high bearing temperatures and will provide a greater margin of safety.

The "make-up" for lost oil, due to leakage and vaporisation, will vary according to the size and operating conditions of the turbine; and when high-grade oils are used, this replacement is usually sufficient to keep the oil in satisfactory working condition for a long time. When, however, the limit of the oil's capacity has been reached, entire replacement with fresh oil is recommended.

When starting up a new turbine for the first time, there are always present in the circulating system impurities, such as cotton waste, rust, sand and dirt, packing material, etc. It is, therefore, good practice to run the turbine for one or two weeks, then remove the entire supply of oil from the system and re-charge with new oil. The oil taken out should be allowed to rest in a large tank to separate it from the impurities. The separated good oil can then be used as "make-up" for the turbine.

Should the charge of oil first removed from the turbine be badly affected by abnormal quantities of impurities, the oil should be heated and, after separation from the bulk of impurities, should be passed through a good filter before use.

After a turbine starts running, the temperature of the oil gradually increases and finally becomes constant; in a small turbine, after four hours' continuous running, and in a large turbine after nearly a whole day's continuous running.

The bulk of the heat absorbed by the oil is removed by means of the cooling coils in the oil cooler. The resultant temperature of the oil depends partly upon the temperature of the cooling water used, but principally upon the capacity and size of the coils in the oil-cooler. Where the main bearings are water-cooled, the temperatures are lowered about 10 deg. F.

The temperatures are very important in judging the efficiency of the lubrication and cooling, and it is a wise precaution to take temperature records every half-hour, or every hour, as follows:—(*a*) Temperature of each main bearing (or of the oil return from each main bearing). (*b*) Temperature of the oil before entering oil cooler. (*c*) Temperature of the oil after leaving oil cooler. (*d*) Temperature of the cooling water entering oil cooler. (*e*) Temperature of the cooling water leaving oil cooler. If any abnormal condition arises in one of the bearings or in the oil cooler the temperature records will immediately locate the place of trouble. By introducing high-grade oils where lower grades have been in use, a reduction in temperature above room of more than 20 per cent. has been obtained, all other conditions being the same.

On occasions, oil vapours come from the bearings and oil tanks, notwithstanding the fact that the bearing temperatures are quite normal. These vapours are drawn into the electric generators from the bearings and may cause disastrous results. The cause of the vapours is the heavy charging of the oil with tiny air bubbles, due to the high speed at which the oil is circulated through the bearings and oil pipes. When the air bubbles burst in the bearings or in the oil tanks, the resultant very fine spray of oil produces the vapours.

The oil will be found creeping over the outside of the main bearings and the turbine frame in a very fine film, and the oil loss may be considerable per 24 hours. The oil return pipes from the bearings should be large enough to carry away the oil, the oil foam, and the oil vapours.

If the pipe is not large enough for this purpose, a remedy for the escape of oil vapours from the bearings is secured by the addition of a vent pipe, venting the oil reservoir of the bearing at a higher level than the original pipe.

As shown in the preceding paragraphs, the oil used in horizontal steam turbines is subjected to severe strain. The general belief among engineers in the past has been that petroleum lubricating oils were indestructible. This is very nearly true in practice, where the older methods of lubrication are employed. Where, however, the turbine is lubricated by means of a circulating system, in which the oil is forced to the bearings under pressure, thence collected, filtered, cooled, and repeatedly returned to undergo the same severe service, deposits may form, due to the breaking down of some portions of the oil from the following causes:—(*a*) Water. (*b*) Solid impurities. (*c*) Air and heat. (*d*) Electric action. (*e*) Adding new oil.

Water has an emulsifying effect on the oil, particularly if the water contains impurities. Where considerable quantities of water leak into the system and emulsification takes place, the mixture becomes yellow or brownish-yellow in colour. If a sample is taken out and heated, it will separate into clean oil at the top, more or less milky water at the bottom, and a spongy sludge separating the two. The clean oil will be found darker in colour than the original, with a strong characteristic odour. It will have a higher viscosity and will contain a percentage of petroleum acids as a result of the breaking down of the oil from oxidation.

These petroleum acids must not be confused with sulphuric acid, which is sometimes found in mineral oils that have been treated with this acid during their manufacture. Most chemists, following the European custom, now report the acidity of used oils in terms of "sulphuric anhydride (SO_3)." The normal alkali used is of such strength that when 25 cubic centimetres are required to neutralise the petroleum acids in 100 grammes of oil, the result is expressed as "1.0 per cent. in terms of SO_3," and this equals "7.05 per cent. in terms of oleic acid."

The petroleum acids do not attack the metals ordinarily used in the construction of steam turbine lubricating systems, but they do slowly dissolve zinc or alloys consisting largely of that metal. The nature of the sludge in the oil, produced by the water, is most objectionable, as it tends to clog the oil strainers, oil inlets to the bearings, and oil inlet to the governor. The oil pressure also will be reduced, if the oil pump fails to deliver the requisite quantity of oil because of the partial choking of the strainers.

Owing to the high temperature at which the oil passes through the circulating system, the oxidising effect of impurities such as iron oxides, dust and dirt, etc., is very considerable, particularly where ordinary oils are in use. The effects produced are the quick darkening of the colour of the oil, a considerable increase in viscosity, the production of a large percentage of petroleum acids, and the breaking down of the oil from oxidation. The oil in this condition smells "burnt" and throws down a slimy deposit which lodges particularly in the oil cooler.

In addition, if there is even a slight leakage of water into

the system, the oil will emulsify badly, owing to its already weakened condition from the oxidising effect of the air and solid impurities. This will explain why, when starting up a new turbine for the first time, emulsification of the oil may occur as a result of the combined effects of the water, air and dirt present, even though the oil may be of high quality.

Occasionally, the inside of the oil tank is painted, and in most cases the oil, in time, dissolves and decomposes the paint, with the result that, in mixing with the oil, the ingredients in the paint cause heavy oxidation of the oil, and in the presence of water emulsification takes place. It is better to keep the inside of the oil tanks scrupulously clean and scraped free from surface rust and dirt, rather than try to cover up the bad surface with a paint that is not "oil-proof."

The circulating oil always contains more or less air, and when the temperature of this oil is above normal, say, higher than 140 deg. F., the air has an increasingly strong tendency to oxidise the oil. This will be realised when it is remembered that the oil film in the bearings is very thin, and that the air is present in very fine bubbles, which are intimately mixed with the oil. The result is that the oil darkens considerably in colour. In extreme cases, a very dangerous black carbon deposit develops, which may choke the oil inlets to the bearings and cause the oil-worked piston in the governor gear to stick.

If there is a leakage of electric current from a direct-current generator, the current will pass through the shaft down through one of the main bearings, through the bedplate, and up through another main bearing back into the shaft. In the case of an alternating-current generator, in which the magnetic field is out of balance, a so-called induced current is produced in the turbine shaft.

In either case, the oil will quickly darken in colour, increase in acidity, and throw down a deposit which will coat all parts of the turbine with which the oil comes in contact, lodging particularly in the oil cooler. This deposit is of a fairly hard, brittle nature, and of a dark chocolate colour; it is exceedingly difficult to remove and is, therefore, very objectionable.

The remedy is to electrically insulate one of the generator main bearings completely from the turbine bedplate, including the connections between the oil pipes and that particular bearing. Such insulation will prevent the passage of an electric current, and, consequently, the formation of deposit.

On rare occasions, local galvanic currents may cause corrosion of the oil tubes in the oil cooler, or of the turbine shaft and bearings, and even corrosion in the governor, causing the oil-operated piston to stick.

Where practically no water enters the circulating system, and where there is practically no waste or leakage of oil, so that the amount of new oil added to the system per week is very small, the oil will, in time, become very dark in colour with considerable increase in acidity. In such cases it has been found that when adding new oil a dark deposit is thrown down throughout the system, due to the action of the old oil on the new; and more particularly is this the case with heavy oils than with light oils.

In reviewing the various causes of the formation of deposit, it will be observed that decomposition of the oil is invariably followed by a darkening in colour and an increase in the percentage of acidity. Therefore, both these features can be taken as standards by which to judge how far the oil has deteriorated; no oil should be used in a turbine if the acidity has reached 0.3 per cent. of petroleum acids in terms of SO_3

Castor oil is still used in marine practice, and also in case of emergency in many plants ashore. It is a great waster of power, increasing the oil friction about 100 per cent. above what a high-grade engine oil will produce. Also, it produces a gummy deposit throughout the circulation system, due to oxidation. On the main bearings of a steam engine where castor oil was fed through an oil-circulating system, the rise in temperature of the bearings above room temperature was 17 deg. F. By gradually introducing a high-grade engine oil the temperature rise was reduced to 8 deg.

In changing over from castor oil, or any other vegetable or animal oil, to an oil largely mineral in character, it is necessary to exercise care and make the change gradually, as deposits which have accumulated from such oils are loosened, and, if loosened too quickly, cause trouble.

The wear and tear of coal-cutters is very great, due to the rough conditions under which they usually operate, and also to the fact that the men operating them do not, as a rule, give the attention to lubrication that is really most necessary in order to prevent too frequent breakdowns. As a rule, the machines require two different oils, one for the gear case, which should be a heavy oil which does not leak out easily from the gear case, and another oil for the motor bearings, in the case of electrically-operated coal-cutters, or for the air-worked engine in the case of an air-worked machine.

The troublesome bearings to lubricate are the vertical disk bearings (disk cutters), the long sleeve surrounding the base of the bar (bar cutters), and the bearings supporting the chain wheel operating near the coal face (chain cutters).

Where machinery works in a dusty atmosphere, dust is apt to cling to the oil, and for this reason ring-oiling bearings have only been a qualified success. The oil wells must be cleaned frequently in order that the oil may render satisfactory service. Oil siphons are easily choked by the dust, but glass-bottle-needle oilers have proved very reliable and satisfactory in a good many cases. They are, however, liable to be broken off and smashed.

Lubricating grease is frequently used either through Stauffer screw-down cups, or through spring grease-cups, and has given good service under a variety of conditions. The grease fills up the bearing completely and forms a protective fillet at either end, which prevents the entrance of dust to the bearing surface.

There is a marked tendency to introduce ball or roller bearings for colliery screening plants and the like, using grease as a lubricant, and filling the bearings completely with grease, so as to prevent the entrance of dust. When oil is used, felt dust-catchers are fitted in the bearings at either end, and when well designed are quite successful. It would seem as if roller bearings or ball bearings could also be introduced with advantage for coal-cutters in connection with the bearings particularly exposed to coal dust.

It is probable that within a few years transformers will undergo material improvements in design. The troubles that have been experienced in the past with sludging of the oil used in transformers, or the "burning out" of the coils, have largely been due to the fact that the transformers have been exposed to the open, allowing impurities of all kinds to enter the transformer casing and mix with the oil.

Furthermore, transformers have been worked more continuously at their full load, and at higher temperatures than was the case formerly when the electric-lighting load was the chief factor to deal with, allowing the transformers to have a rest and cool down between the peak loads.

Transformers are now being made with "breathers" attached above the oil level, provided with traps to extract the moisture from the air which is inhaled as the transformer cools and the oil shrinks. In other cases an expansion chamber is provided, in which the oil can expand or contract, but where no new air is introduced during the normal operation of the transformer.

Not counting the cases where sludge has been produced by impurities mixing with the oil (open-type transformers), or where the sludge has been due to bad insulating material (which has been affected by the oil), the deposit produced by sludging is always the result of oxidation, and has only taken place where the working temperatures of the transformer have been above a certain critical temperature, which critical temperature is different for different oils. For these reasons it is obvious that if the transformer casing is hermetically closed, and no renewal of air can take place, the danger of sludging will be very greatly minimised.

As to general characteristics of transformer oils, they should be possessed of good dielectric strength and high specific resistance in order to perform their functions as insulating mediums. A low viscosity is always a great advantage, also a great coefficient of expansion, as these two features combined mean quick circulation of the oil, enabling the heat from the windings to be dispersed quickly into the body of the oil, and finally to the transformer casing, from which the heat eventually radiates into the surrounding air.

As regards oil switches, the conditions in D.C. switches are much more severe than in A.C. switches. The desirability of low viscosity is obvious for switch purposes, as the more mobile the oil, the quicker will the arc be quenched. The oil should produce as little carbon as possible, and oils in which the carbon quickly flocculates and sinks to the bottom are to be preferred to oils in which the carbon is kept more or less floating.

It is important that the oil level should be kept high in the switch case, covering the contacts to a sufficient depth, so that even with the strongest current there is no chance of the spark breaking through to the surface and igniting the gases that may be present. With reference to this latter point, the ventilation of the switch case is important, and it is also important that the switch case should be kept as full of oil as possible, leaving a minimum space for the gases to accumulate.

Electrical Trades Benevolent Institution.—In a circular letter the President of this Institution, Sir David Salomons, informs its friends that owing to the war, the annual Festival of the Electrical Trades Benevolent Institution will not be held this year. As the cancellation of the Festival deprives the fund of its chief source of income at a time when very heavy demands are made upon its resources, the Committee appeals to subscribers to renew their contributions upon an even more liberal basis than in past years, and expresses the hope that the urgency of the claims made upon the fund will bring a large influx of new subscribers. It is suggested that subscribers should add to their usual donations the guinea which would otherwise have been spent upon the ticket for the Festival. Whilst admitting that many calls are now being made for benevolent purposes, Sir David Salomons points out that this appeal is being confined to those who are actually engaged in the electrical industries, and is made on behalf of fellow workers whose needs are great and increasing. We cordially recommend the matter to the notice of our readers, assuring them, with the confidence born of personal knowledge, that the Institution is in every way worthy of their support, and that the continuous demands that are now being made upon its funds render it an urgent necessity that those funds should be greatly increased.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

11,443. "Spark gaps for wireless telegraphy." G. V. A. G. Mathieu. August 9th. (Complete.)

11,457. "Electricity distributing networks." M. Hochstadter. August 9th. (Complete.)

11,473. "Alternating-current motors." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 9th.

11,480. "Band resistance for use with electric pedal switches." R. Bosch (firm of). August 9th. (Divided application on 2,236/15. Convention date, July 29th, 1914, Germany.) (Complete.)

11,510. "Dynamo-electric machines." U.S. Light & Heat Corporation. August 9th. (Convention date, August 14th, 1914, United States.) (Complete.)

11,511. "Leclanche cells, and methods of and means for resuscitating the same when apparently exhausted." J. T. Fahy & A. E. Otway. August 9th. (Complete.)

11,512. "Electric connections for electrically-heated irons and the like utensils." C. Kretz. August 9th.

11,544. "Manufacture of incandescent electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 10th.

11,553. "Electrically operating alarms and signals." J. R. Quain. August 10th

11,555. "Production of undamped or sustained electrical oscillations." F. K. Vreeland. August 10th. (Complete.)

11,566. "Explosion engines with dynamo-magnetic ignition." Soc. Anon. des Etablissements L. Bleriot. August 10th. (Convention date, September 16th, 1914, France.) (Complete.)

11,568. "Electrical transformers." A. Schaanning & G. Harlow. August 10th.

11,598. "Electrical transmission gears." R. E. Raven. August 11th.

11,600. "Automatic telephone systems." Relay Automatic Telephone Co., Ltd., F. M. Ward, G. H. Bryant, & T. M. Inman. August 11th.

11,603. "Control of hydro-extractors." T. Broadbent & Sons, Ltd. British Thomson-Houston Co., Ltd., and W. L. Wise. August 11th.

11,655. "Telephone systems." Relay Automatic Telephone Co. & W. Aitken. August 12th.

11,658. "Pneumatically-operated controllers." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 12th.

11,660. "Arc lamp with enclosed voltaic arc." Allgemeine Elektricitats Ges. August 12th. (Convention date, August 13th, 1914, Germany.) (Complete.)

11,690. "Electric regulator or governor." B. O. Holm-Hansen. August 12th. (Complete.)

11,712. "Electric generators." D. Suchostawer. August 13th.

11,715. "Pivots and jewels for measuring-instruments and the like, and methods of manufacturing the same." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 13th.

11,723. "Lamp-holders for electric lamps." E. F. Guth. August 13th. (Convention date, January 21st, 1915, United States). (Complete.)

11,768. "Systems of control for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 14th.

11,776. "Telegraphic transmitting apparatus." F. B. Dahl. August 14th.

PUBLISHED SPECIFICATIONS.

1914.

1,157. Telephone Systems. Siemens & Halske Akt. Ges., E. A. Laidlaw, and T. Feltkew. January 15th. (Additions to 18,498/12.)

1,181. Method of Producing Movements of an Indicator or the like in Electric Apparatus for other instruments. W. Lubach. January 15th.

1,452. Overhead Conductors of Electric Railways. K. von Kando. January 19th.

2,424. Loud-speaking Telephones. Sterling Telephone & Electric Co., Ltd. (Telephon-Fabrik Akt. Ges. vorm J. Berliner). January 19th.

2,548. Electric Accumulators. Van Raden & Co., Ltd., and M. Metz January 31st.

3,209. Manufacture of Incandescent Electric Lamps. C. Gladitz. February 6th.

3,311. Protection of Electric Circuits against the Influence of Alternating Currents. K. von. Kando. February 7th.

3,658. Working or Controlling of Electrical Machinery. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.). February 12th. (Addition to 1,716/10.)

4,188. Electric Signalling Systems for Burglar and Fire Alarms. O. Reich. February 18th.

4,223. Signalling Apparatus for Mines. Sterling Telephone & Electric Co. (Telephon Fabrik Akt. Ges. vorm J. Berliner). February 18th.

4,233. Electrically-driven Vehicles. K. von Kando. February 18th. (Addition to 963/14.)

4,803. Alternating-current Motors. Phœnix Dynamo Manufacturing Co. and R. Pohl. February 24th.

7,342. Electric Motors. E. K. Kennard. March 23rd. (October 23rd, 1914.)

11,211. Register Circuits for Telephone Installations with Separate Setting and Speaking Paths. Siemens & Halske Akt. Ges. May 6th. (May 6th, 1913. Patent of addition not granted.)

11,621. Machine for Cutting Electric Bulbs for Regenerating them. Baron A. O. von Bétorkéz und Verinkház. May 11th. (May 10th, 1913.)

11,709. Antennæ for Wireless Telegraphy or Telephony. J. Schiessler December 20th. (Divided from 29,447/13, October 16th.)

12,259. Method and Means for the Production of Sustained Electric Oscillations, particularly for Radio-telegraphy and Radio-telephony. W. J. Mellersh-Jackson (Fratelli Marzi di G.B.) May 18th.

14,746. Covers or Fittings for Electrical Conduits. H. H. Longbottom. and T. Farrar. June 19th. (December 21st, 1914.)

15,539. Electric Railway Systems. Right Hon. C. E. H. Hobhouse, W. Slingo, H. C. Gunton, W. H. Powell, and J. R. Kingston. June 29th.

17,455. Means for Cooling Electro-magnetic Friction Clutches, and more particularly Reversing Clutches. "Vulkan" Maschinenfabriks Akt. Ges. July 23rd. (August 16th, 1913.)

17,511. Electrically-operated Fastenings for Railway Carriage Doors and the like. J. E. Crossley. July 24th.

17,628 Electrical Dust Suction Apparatus. Bünte & Remmler (firm of) July 25 (August 29th, 1913.)

17,920. Telegraph Circuits. A. Orling & Orling's Telegraph Instruments Syndicate, Ltd. July 29th. (Cognate application, 23,167/14.)

18,202. Step-by-step Mechanism suitable for Starting Electric Motors. Sir W. G. Armstrong, Whitworth & Co., Ltd., and W. H. Waddingham. August 1st.

18,353. Starters for Electric Motors. Siemens Bros. Dynamo Works and E. Schupp. August 7th. (Addition to 5,514/14.)

18,465. Excess Voltage Devices for Protecting Electrical Circuits and Apparatus. Siemens Schuckertwerke Ges. August 8th. (August 21st, 1913.)

18,751. Coherers. British Thomson-Houston Co. (General Electric Co., United States). August 17th.

20,137. Circuit Arrangements for Writing Telegraphs. A. G. Bloxam. (Telepantograph Ges.). September 24th.

20,322. Control of Electric Motors. Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). September 29th.

20,409. Fusible Filling and Insulating Material for Electrical Purposes. H. Grossman. October 1st.

21,643. Electrically-operated Alarm Device for use in connection with Door Locks and Catches. T. Kerr. October 28th.

21,676. Squirrel-cage Windings of Dynamo-electric Machines. British Thomson-Houston Co., Ltd. (General Electric Co., United States). October 28th.

21,766. Electric Concertina. N. W. M. Holt. October 30th.

22,150. Electric Water-heater. J. F. Wheelock. November 6th.

22,248. Electric Transformers. O. Imray (Siemens Schuckertwerke Ges.). November 9th.

24,496. Apparatus for Cooling Electric Motors. J. W. Nolan. December 22nd. (February 2nd, 1914.)

1915.

1,006. Register Circuits for Telephone Systems. O. Imray (Siemens and Halse Akt. Ges.). January 21st.

1,973. Electro-optical Cells. C. Stille. February 8th. (February 6th, 1914.)

1,995. Means for Setting Selecting Devices by Electric Current Impulses. O. Imray (Siemens & Halske Akt. Ges.). February 8th.

2,093. Electric Wave Amplifying Apparatus. Western Electric Co., Ltd. (Western Electric Co.). February 9th. (Addition to 275/15.)

2,462. Arrangement for the practically Sparkless Interruption of an Electric Current. Fried. Krupp Akt. Ges. February 16th. (February 19th, 1914.)

3,213. Device for Anchoring or Attaching Unarmoured Electric Cables and Wires to Apparatus or Fittings. A. E. Foster. February 27th.

4,353. Thermic Telephones. Elektrotechnische Spezialkonstruktionen Ges. March 19th. (March 24th, 1914.)

4,912. Transmission of Sound Waves. E. M. Tigerstedt. March 30th. (March 30th, 1914.)

6,805. Apparatus for the Electric Transmission of the Energy of a Heat Motor to the Driving Wheels of a Vehicle or the like. P. Biles. May 6th. (Divided application on 10,275/14, April 25th.)

7,963. Telephone Instruments. G. G. Turri. May 28th. (June 1st, 1914.)

Utilising Scrap Nickel Anodes.—The loss on sale of worn-out anodes has always been a weak point in the electro-plater's balance-sheet. Due to a variety of causes, the anode rods or plates dissolve more or less unevenly so as to become unsafe for use long before the weight of metal has been reduced to the limit theoretically imposed by consideration of current-carrying section and active surface area. The metal in the "worn-out" anode is every bit as good as that already dissolved away, but the scrap price obtainable for it is only about half the price per lb. for new anode metal. By inverting anodes after they have been in use for a time, something can be done to even out the distribution of wear, but a big wastage still occurs. Attempts have been made in the past to hold together a number of pieces of scrap nickel anode by drilling them and pressing a lead "rivet" through the holes. Sometimes the result is satisfactory, but more often it is not, since dependence has to be placed almost entirely on the lead rivet for interconnection, and imperfect contact means more or less of the built-up anode being ineffective.

The exact form of the anode is unimportant. All that is necessary is that it should be of sufficient superficial area, electrically continuous throughout, and free from any metal setting up local electrolytic action or (which would be more serious) dissolving in preference to the main anode and contaminating the deposit on the work. A certain American plating firm practises a method which is at once simple, economical, and electrochemically unobjectionable. Bar anodes of elliptical section are used in the first place, and when these become broken or too reduced in area, a number of those most worn are welded together to form an electrode, which is just as effective as a new bar. The brass hooks used to suspend the anodes in the first place are melted out of the ends of the scrap by aid of an oxy-acetylene flame, which is then used to weld together as many pieces of scrap nickel as may be necessary to form the equivalent of at least one new bar anode. No flux is required, the pieces of scrap being easily fused together, while holding another piece in the welding flame for "filling" purposes. So long as the joints are sound, their appearance is quite immaterial, and no particular skill is required to do the work. Between 100 and 150 cb. ft. each of oxygen and acetylene is sufficient to weld up a hundredweight of scrap bar anodes, the time required being six or seven hours. The cost of rendering the scrap fit for re-use is somewhere about 3d. a lb., and the effect of so doing is to double the actual value of the metal by converting it in effect, to new metal. With anodes at 3s. a lb. there should be a net gain of at least 1s. 3d. a lb. on all scrap welded up for re use. Only a negligible amount of metal need be sold as scrap, and the process certainly deserves to be generally known and adopted, for no special equipment or training is required to put it into practice, and just at present, in particular, any means of reducing the consumption of new metal is of particular importance, owing to high prices and delay in delivery.